Universidad de Alcalá

TEACHING GUIDE

Fundamentals of Electronics

Degree in
Industrial Technologies Engineering

Universidad de Alcalá

Academic Year 2022/2023

2nd Year - 2nd Semester

Approved by the School Board on June 3, 2022

TEACHING GUIDE

Course Name:	**Fundamentals of Electronics**
Code:	**610017**
Degree in:	**Industrial Technologies Engineering**
Department and area:	**Electrónica** **Electronic Technology**
Type:	**Compulsory**
ECTS Credits:	**6.0**
Year and semester:	**2nd Year, 2nd Semester**
Teachers:	Check Website in UAH
Tutoring schedule:	By appointment
Language:	Spanish/English Friendly

1. COURSE SUMMARY

This course aims to introduce the student to the fundamentals of electronics in both analog and digital applications. A theoretical-practical approach is adopted in order to facilitate the acquisition of the competences corresponding to the Degree in Engineering in Industrial Technologies. For this, electronic devices and subsystems are studied in detail, together with the functions that they must develop within broader industrial systems.

The course begins with an overview of the electronic systems, the blocks and functions that can be found in such systems, the existing signals in each block and the information transferred and converted between blocks.

Next, the study of analog electronic systems is introduced, with a first description of the functions performed: amplification, wave shaping and filtering. The study of basic analog devices continues, starting with the Operational Amplifier and its basic configurations; this study is completed both in time and in frequency. After a brief introduction to semiconductor diodes, the wave shaping and rectification functions will be studied.

Going from analog to digital environments, a study of the comparator circuits is done. BJT and MOS transistors are introduced at a functional level, as amplifier and switcher devices.

The final block introduces the basic structure of digital systems and CMOS technologies. The study continues with basic digital functions going from combinational to sequential circuits. This block ends with an introduction to Programmable Digital Systems and their possibilities of control and interaction with the environment.

To be able to pass this subject, the student will need some background and previous knowledge about electrical circuit's analysis and basic electronics, as specified in the official programs of the current degree.

With a deeper detail, the student must have a suitable level of knowledge and competence about the following concepts: electrical signals, both in DC and AC; characterisation and identification of waveforms, both in time and frequency domains, average and RMS values of them, when required; elements of a linear electrical circuit (R, L, C and generators); theorems and laws of circuit analysis (Kirchoff, Thevenin, Norton and superposition); basic knowledge of analysis in Fourier (AC) and Laplace (transient) domains.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills:

en_CG1 - Ability to develop projects in the field of industrial engineering whose purpose is the construction, reform, repair, conservation, demolition, manufacture, installation, assembly or exploitation of: structures, mechanical equipment, energy installations, electrical and electronic installations, industrial plants and facilities and manufacturing and automation processes.

en_CG2 - Knowledge of basic and technological subjects, which enables them to learn new methods and theories, and endow them with versatility to adapt to new situations.

en_CG3 - Ability to solve problems with initiative, decision making, creativity, critical reasoning and communication and transmission of knowledge, abilities and skills in the field of Industrial Engineering.

en_CG4 - Knowledge and ability to apply computational and experimental tools for solving problems in the field of Industrial Engineering.

Specific Skills

This course contributes to acquire the following specific skills:

en_CRI5 - Knowledge of the fundamentals of electronics.

Learning Outcomes

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

RAFSEA-1. Identify and characterize basic electronic devices (passive and active). Their operating principle; symbols; functional areas; parameters; and typical applications

RAFSEA-2. Model and parameterize properly basic amplification stages, both in time and in frequency.

RAFSEA-3. Planning and programming simple tasks on basic microprocessor-based digital systems.

RAFSEA-4. Correct use of applications and programs to support the design and modelling of electronic circuits (both analog and digital).

RAFSEA-5. Correct use of the appropriate instrumentation to check and measure the characteristics of electronic circuits.

3. CONTENTS

Bloques de contenido	Total de clases, créditos u horas
Block 1: Introduction to Electronic Systems. Functions developed by the Electronic Systems. Analog, digital and combined systems. Passive and active electronic devices.	6 hours
Block 2: Analog Electronic Systems. Basic functions: amplification, filtering, and wave shaping. Operational Amplifiers: basic configurations. Study in time and frequency.	13 hours +1 h. Eval.
Block 3: Non-linear devices and systems. Semiconductor diodes: protection, shaping and wave rectification functions. BJT and MOS transistors: functions as amplifiers and switches. Comparator circuits. Introduction to A/D and D/A conversion.	10 hours
Block 4: Digital Electronic Systems. CMOS technology. PLD circuits. Combinational and sequential digital functions. Programmable digital systems: ALU, memories and I/O devices. Microprocessor and microcontroller devices.	13 hours +1 h. Eval.
Laboratory sessions (LAB). Complementary works related with each block, in sync with their contents. Lab activities are: analysis, design and experimentation of amplifiers; analog simulation; introduction to programmable digital systems; mixed analog-digital applications.	14 hours
Total of classroom activities:	56 hours +2 h. Eval.

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 uses the following activities:

- **Theoretical-practical sessions.** Topics of interest: theoretical fundamentals, antecedents and applicable analysis and/or modeling techniques; analysis and design tools available; documental references. There will be formative exercises, working these phases: problem statement (analysis and/or design); resolution techniques; sources of information and management of support tools.

- **Experimental sessions, in the laboratory.** Complementing the theoretical-practical sessions, working on experimental cases that require the use of instrumentation and/or physical equipment. Working plans: problem statement (analysis and/or design); resolution techniques; information sources and management of support tools; associated, operational instrumentation and interpretation of results.

- **Tests, exercises and/or follow-up problems.** Exercises and problems to be solved by the students alone or within a group, proposed inside each thematic or activity block. In some cases, the student or group of students must publicly present their solutions and/or results obtained during or at the end of the resolution of the proposed test.

- **Individual and Group Tutoring.** Either individually or in groups, these tutorials will allow answering the questions and strengthening the knowledge acquired by the students. In addition, they will help to monitor students and evaluate the proper functioning of teaching-learning mechanisms.

Some of the proposed exercises or practices will be carried out within controlled environments, in time and resources, in order to check the degree of individual acquisition (by each student) of the training objectives set.

The teaching staff will facilitate the materials for the module (theoretical, exercises and problems, practice manuals, visual references, etc.), so the students can reach the course objectives while getting familiar with the documentation used in professional environments

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.

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. Identifying and explaining 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. Solving simple exercises of electronic circuit synthesis from a given set of specifications.

CE4. Justifying reasonably the steps followed when solving a problem of electronic circuit analysis and synthesis.

CE5. Assembling electronic circuits without errors, and measure their characteristics and fundamental parameters.

CE6. Documenting properly 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 (CAM), 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 that date.

- **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
CRI-5. CG: 1, 2, 3 y 4.	RAFSEA: 1, 2, 3 and 4 (note 1)	CE: 1, 2, 3 and 4.	**EJ**	10%
CRI-5. CG: 1, 2, 3 y 4.	RAFSEA: 1, 2, 3 and 4 (note 1)	CE: 1, 2, 3 and 4.	**PEI**	20%
CRI-5. CG: 1, 2, 3 y 4.	RAFSEA: 1, 2, 3, 4 and 5 (note 2)	CE: 1, 2, 3, 4, 5 and 6 (note 2)	**LAB**	30%
CRI-5. CG: 1, 2, 3 y 4.	RAFSEA: 1, 2, 3 and 4	CE: 1, 2, 3 and 4.	**PC**	40%

Note 1: The assessment of the RAFSEA 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:

- **Experimental section:** the student must have successfully acquired the skills related to the laboratory assignment (**LAB**), according to criteria published in practice guides and in the individual tests. This criteria is met if their score is equal (or higher) to 50% of the maximum score (**5 out of 10**).
- **Theoretical-practical section:** the student must have successfully acquired the skills related to the set of all tests and theoretical-practical assignments (if any) **[EJ+PEI+PC]**. This criteria is met if their average score in all related assignments and tests is equal (or higher) to 50% of the maximum obtainable score (**5 out of 10**).
- **Global criteria:** the minimum final weighted score of the two previous sections should be **at least 5 out of 10** to pass the whole subject. This final score will be computed also if one of the two sections gets just **4,5 out of 10** points.
- If global criteria is not accomplished the final mark would be the lower of the following:
  - The final weighted score.
  - 4 out of 10 points.
- If the global criteria is not accomplished the student could keep the marks obtained in any section up to the Extraordinary Call if they are equal or higher than 5 out of 10.

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 in addition to 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 teaching sessions

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
CRI-5. CG: 1, 2, 3 y 4.	RAFSEA: 1, 2, 3 and 4.	CE: 1, 2, 3 and 4.	**PC**	70%
CRI-5. CG: 1, 2, 3 y 4.	RAFSEA: 1, 2, 3, 4 and 5.	CE: 1, 2, 3, 4, 5 and 6 (note 1)	**LAB** (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.
- “Electronics”. Allan R. Hambley. Ed Pearson Education, Madrid 2001. ISBN: 84-205-2999-0.
- “Digital Fundamentals”. Thomas L. Floyd. 11th Edition. Editorial: Prentice-Hall (2015). ISBN-13: 978-0133514896.

6.2. Additional Bibliography

- “Circuitos Electrónicos. Análisis, simulación y diseño”. Norbert R. Malik. Ed.: Prentice-Hall. 1997. ISBN-13: 978-84896.60038.
- “Embedded Systems: Introduction to Arm® Cortex(TM)-M Microcontrollers (Volume 1)”. Jonathan W. Valvano. Edition: CreateSpace Independent Publishing Platform (May 26, 2012). ISBN-13: 978-14775.08992.
- “Embedded Systems: Real-Time Interfacing to Arm® Cortex(TM)-M Microcontrollers (Volume 2)”. Jonathan W. Valvano. Edition: CreateSpace Independent Publishing Platform (May 26, 2012). ISBN-13: 978-14635.90154.

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.