Universidad de Alcalá

TEACHING GUIDE

Analog 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:	**Analog Electronics**
Code:	**600008**
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:	Check Website in UAH
Tutoring schedule:	By appointment
Language:	English

1. COURSE SUMMARY

The subject *600008-Analog Electronics* aims to introduce students to the study of the basic devices and configurations of electronic systems.

Students will learn about configurations and typical properties of the analog circuits (amplifiers, rectifiers, etc.), semiconductor based devices (discrete and integrated), their characteristics and their typical applications, i.e. analog signals and commutation (switching).

The module also deals with the study of amplifiers and its frequency response, as well as the advantages coming from the feedback techniques.

The module is followed in the second semester by the subject *600012-Electronic Technology*, and it prepares students with the basic concepts and techniques which are necessary for successfully studying linear electronic circuits in subsequent modules.

In order to be able to benefit from this module students must have studied Circuit Analysis in the first year of their degree. It is also recommended that students have studied Physics II. Consequently, students are able to work on the following general concepts: properties of devices and linear networks (R, L, C and generators); DC and AC circuits analysis; superposition; Thévenin and Norton equivalent circuits; transient response concepts (Laplace domain circuits).

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_CI5 - Knowledge of the fundamentals of electronics.

Learning Outcomes

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

RASEEA7. To explain the fundamentals and applications of analog electronics.

RASEEA8. To model a generic amplifier and obtain the parameters that define it: gains, terminal impedances and frequency response.

RASEEA9. To analyse and design electronic circuits described by only one time constant, depending on time or frequency parameters.

RASEEA10. To explain the basic characteristic parameters of the ideal and real operational amplifiers.

RASEEA11. To analyse and design basic linear and non-linear electronic circuits by using operational amplifiers.

RASEEA12. To show basic knowledge of semiconductors and electronic circuits, describing their functionality.

RASEEA13. To analyse and design basic linear and non-linear electronic circuits by using semiconductor diodes.

RASEEA14. To explain the functionality of electronic and photonic devices and their application areas.

3. CONTENTS

Contents Blocks	Total number of hours
Block 1: Fundamental Properties of Amplifiers. Introduction. Basic concepts. Modelling of devices and circuits. Ideal amplifiers. Loading effects, distortion.	4 hours
Block 2: Operational Amplifiers. Ideal Operational Amplifier. Feedback concept. Basic amplifier configurations. Linear applications. Real operational amplifiers: limits and design criteria. Non-linear applications: comparators.	15 hours
Block 3: Time and frequency response. Transfer functions, G(s), Zeroes and poles. Bode diagrams (module and phase). Frequency bands: LF, HF and middle frequencies. Cut frequencies. Dominant poles. Time and frequency behaviour of first order networks. Slew-Rate and Gain-Bandwidth limits.	12 hours
Block 4: Diodes. Behaviour, types, curves and large signal modelling. Basic applications: rectifiers, limiters and wave shaping. Photonic devices: Photodiodes and LEDs.	12 hours
Laboratory sessions (LAB). Design of basic analog circuits. Assembly and measurements. Introduction to Spice. Operational amplifiers, comparators, and diode-based circuits.	15 hours
Total hours of in-class activities:	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 in large 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 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. 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:

- **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 (PF)**. 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
CI5. TR: 2, 3, 9.	RASEEA: 7, 8, 9, 10, 11, 12, 13 and 14 (note 1)	CE: 1, 2, 3, 4.	**PEI**	30%
CI5. TR: 2, 3, 4, 9.	RASEEA: 7, 8, 9, 10, 11, 12, 13 and 14	CE: 1, 2, 3, 4, 5, 6. (note 2)	**LAB**	30%
CI5. TR: 2, 3, 9.	RASEEA: 7, 8, 9, 10, 11, 12, 13 and 14	CE: 1, 2, 3, 4.	**PF**	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 **(THEO-PRAC)** assignments if they obtain an overall weighted grade equal to or higher than **4.5 out of 10**. This grade can be obtained as the highest grade between [PEI+PF] or [PF+REC]; where the REC is a PEI re-assessment test, with a weight of 20% on the final grade, that will be taken with the overall test (PC).

If one of the previous parts is not passed (LAB or THEO-PRAC), the final mark would be the lower of:

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

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
CI5. TR: 2, 3, 9	RASEEA: 7, 8, 9, 10, 11, 12, 13 and 14.	CE: 1, 2, 3, 4.	**PF**	70%
CI5. TR: 2, 3, 9	RASEEA: 7, 8, 9, 10, 11, 12, 13 and 14.	CE: 1, 2, 3, 4, 5, 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 PF.

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.

The teaching-learning methodology and the assessment process will be adapted as needed, in accordance with the guidelines of the Diversity Support Unit, to implement curricular adaptations for students with specific needs.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- "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.
- 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.

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

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.