Universidad de Alcalá

TEACHING GUIDE

Circuit Electronics

Degree in
Telecommunication Technologies Engineering (GITT)
Telecommunication Systems Engineering (GIST)
Telematics Engineering (GIT)
Electronic Communications Engineering (GIEC)

Universidad de Alcalá

Academic Year 2022/2023

2nd Year - 2nd Semester (GITT+GIST+GIT+GIEC)

Approved by the School Board on June 3, 2022

TEACHING GUIDE

Course Name:	**Circuit Electronics**
Code:	**350018 (GITT+GIST+GIT+GIEC)**
Degree in:	**Telecommunication Technologies Engineering (GITT)** **Telecommunication Systems Engineering (GIST)** **Telematics Engineering (GIT)** **Electronic Communications Engineering (GIEC)**
Department and area:	**Electrónica** **Electronic Technology**
Type:	**Compulsory (GITT+GIST+GIT+GIEC)**
ECTS Credits:	**6.0**
Year and semester:	**2nd Year - 2nd Semester (GITT+GIST+GIT+GIEC)**
Teachers:	Check website: http://www.depeca.uah.es
Tutoring schedule:	Check website: http://www.depeca.uah.es
Language:	English

1. COURSE SUMMARY

The subject of Electronic Circuits 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.

We study here the properties of several discrete transistor amplifiers, the properties and effects of the frequency response of amplifiers, and feedback techniques. It also deals with the study of the characteristics and properties of the circuits and power amplifiers, integrated amplifiers including power supplies. In another block, it completes the vision of electronic circuits addressing the problem of data conversion (analog to digital and vice versa) and an introduction to systems acquisition.

This course builds on the skills and knowledge acquired in previous courses as follows:

- Basic Electronics: Basic amplification concepts, modeling, ideal and real amplifiers, loading effects, introduction to frequency response, operational amplifiers and applications, analysis of circuits based on semiconductor devices (diodes and transistors), with special emphasis on transistor based amplifiers (small signal and polarization).
- Calculus I: Laplace Transform and Fourier Transform
- Circuits Theory: Circuit analysis, laboratory instrumentation and measurements (voltages and phase differences), circuit assembly in prototype boards.
- Circuit Analysis: two port networks, analysis in the time domain and the Laplace transform domain, first and second order filter transfer functions, analysis with circuit simulation tools.
- Signals and Systems: Laplace transform, Fourier transform, filtering concept.

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/352/2009:

en_TR2 - Knowledge of basic subjects and technologies that enables to learn new methods and technologies, as well as to provide versatility that allows adaptation to new situations.

en_TR8 - Capacity of working in a multidisciplinary and multilingual team and of communicating, both in spoken and written language, knowledge, procedures, results and ideas related to telecommunications and electronics.

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/352/2009:

en_CT1 - Skills for autonomous learning of new concepts and techniques suitable for the conception, development or commissioning of telecommunication systems and services.

en_CT3 - Ability to use computer tools to search bibliographic resources or information relating to telecommunications and electronics.

en_CT11 - Ability to use different energy sources especially solar photovoltaic and thermal, as well as the fundamentals of electrical engineering and power electronics.

Learning Outcomes

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

RA1. Analyze and adjust the characteristics of multistage and differential amplifiers, explaining the procedures used and identifying the applied models and the elements to take into account.

RA2. Analyze and adjust the frequency response of the amplifiers, explaining the procedures used and identifying the applicable models and the active and passive elements to take into account.

RA3. Analyze and adjust the characteristics of an amplifier using feedback techniques, explaining the procedures used and identifying the applicable models and the benefits and risks of these techniques.

RA4. Analyze and adjust linear power amplification stages, explaining the procedures used and identifying the applicable models and the fundamental criteria referred to power balance and secure operation area.

RA5. Describe other alternatives of basic circuits to control energy transfer: integrated linear amplifiers and power supplies.

RA6. Describe the elements of an acquisition data system, and different alternatives for analog to digital and digital to analog conversion.

RA7. Design, simulate, assemble and measure basic electronic circuits, applying the acquired knowledge, documenting and justifying the obtained results.

3. CONTENTS

Contents Blocks	Total number of hours
Amplification stages. Differential amplifiers, DC and AC characteristics. Integrated Amplifiers: current sources, mirrors and active loads.	• 13 hours
Frequency Response. Amplification at low and high frequencies.	• 13 hours
Feedback. Fundamental relationships and ideal settings. Analysis of real circuits. Stability: analysis and compensation methods.	• 13 hours
Circuits and power amplifiers. Linear Amplifiers: Class A, B and AB. Integrated Amplifiers. Power.	• 13 hours
Circuits Analog-Digital Interface. Introduction to data acquisition systems: Sampling-hold circuits, analog-digital converters, digital-analog converters.	• 4 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 comprise 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 classes will present essential contents later serving to develop broader skills.
- Practical classes 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.
- Tutoring: individual and groupal.
- Definition of work to be carried out by the students before and after the theoretical and practical sessions, an essential part of the teaching-learning process

The following additional resources man 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 to 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 circuits 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 materials needed to facilitate the course following (theoretical, exercises and problems, practice manuals, visual references, etc.) So that students can meet the objectives of the course and achieve the powers provided.

The student may attend group tutorships (if requested by the students) and individual ones according to his/her needs and after agreement with the corresponding lecturers. Whether individually or in small groups, these tutorships will allow to solve the doubts 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 (transparencies, set of exercises and solutions, problem statements for practices, 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 (Regulations for the Regulation of Teaching Learning Processes, NRPEA, 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 Regulations for the Evaluation of Apprenticeships (approved by the Governing Council on March 24, 2011 and modified in the Board of Directors). Government of May 5, 2016) 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.

According to current regulations and considering that the experimental laboratory is essential for the acquisition of the course skills, attendance to all laboratory sessions is compulsory as well as passing its evaluation, for both the ordinary and the extraordinary evaluation (Article 6, paragraph 4, NRPEA). For this reason, the laboratory attendance and evaluation are common and essential in the two types of evaluation: continuous and non-continuous.

5.2. EVALUATION

EVALUATION CRITERIA

The evaluation process aims at assessing the degree and depth of the student's acquisition of the course skills. 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:** The student correctly applies and develops the theoretical foundations, the models and the resolution techniques to analyze electronic circuits, in the context of the course content.
- **CE2:** The student solves simple problems on the synthesis of electronic circuits, from a given set of specifications, within the context of the course content.
- **CE3:** The student justifies the steps followed to solve the electronic circuit analysis and synthesis problems, in the context of the course content.
- **CE4:** The student is able to simulate and assemble electronic circuits without errors and measure its characteristics and fundamental parameters, in the context of the course content.
- **CE5:** The student shows capacity and initiative, being able to find out in an autonomous way, the fundamental properties of the electronic circuits, the applicable models and their operation limits.
- **CE6:** The student shows capacity to document, adequately and justifiably, the practical and theoretical works carried out, in the context of the course content.

EVALUATION INSTRUMENTS

To assess the evaluation criteria, the following evaluation instruments will be used.

1. Intermediate Assessment Tests (PEI): consisting on solving several questions, on analysis and/or synthesis, on specific aspects of the concepts related to the theory, problems and laboratory classes.
2. In class activities (ACTP): consisting on solving problems, theoretical or practical tests, and formative and evaluation activities.
3. Out of class activities (ACTNP): consisting on previous study, and its verification through questionnaires, and formative and evaluation activities.
4. Laboratory practices (PL): consisting on using instrumentation equipment, and design, simulation and assembly of electronic circuits. In the lab a continuous follow-up on the students´ progress is carried out.
5. Final evaluation exam (PEF): a written exam on problem solving, related to the concepts exposed in all the course units.

PROCEDURES AND GRADING TOOLS

Ordinary evaluation:

1) Continuous evaluation. Students who opt for continuous assessment shall perform the following tests throughout the course:

a. In class activities (ACTP, theoretical or practical tests or problems, and formative and evaluation activities), and out of class activities (ACTNP, previous study and its verification through questionnaires, and formative and evaluation activities **(15% of the final grade of the student).**
b. One or more intermediate assessment tests (PEI) which consist of a number of questions and/or problems, covering one or more topics within the course content **(25% of the final grade of the student).**
c. Laboratory assignments, of compulsory attendance. The assignment will complement the knowledge acquired in the theoretical part of the course **(20% of the final grade of the student).**
d. Overall exam (PEF), held at the end of the course, with a number of questions and problems (analysis and/or synthesis) on specific aspects of the full course syllabus, covered by the theory, problems and laboratory classes **(40% of the final mark student).** With this exam the capability of relating and integrating the learnt concepts is evaluated, and also allows revising the concepts of the intermediate tests. For all this, the overall exam allows to improve the final mark if the score is better than the one obtained in the accumulation of the intermediate tests and the overall exam.

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 (paragraph 1.c above). It is understood that a student successfully acquire these skills, if her/his score is equal or higher to 50% of the maximum obtainable score.
- They have successfully acquired the skills related to the set of all tests, exercises and theoretical-practical written or oral assignments (if any), intermediate assessment tests (PEIs), and the overall exam (paragraph 1.a, 1.b and 1,d). It is understood that a student successfully acquire these skills, if her/his average score in all related assignments and tests is equal or higher to 45% of the maximum obtainable score.
- The final weighted score of all of the above items (paragraphs 1.a, 1.b, 1.c, and 1.d) turns out to be equal or higher than 5 out of 10.

Students who follow the continuous evaluation model, will be considered as not presented when they do not attend the overall exam.

2) Non continuous evaluation. Students who opt for the non-continuous evaluation will make a final exam and the mandatory laboratory assignment, with the following weights in the final grade:

a. The theoretical and practical final test (PEF), broadly covering the contents of all the course topics **(80%).**
b. The laboratory assignment, of compulsory attendance, described in the continuous evaluation section **(20%).**

The evaluation criteria are the same than that exposed in the continuous evaluation section.

Extraordinary evaluation:

For the continuous and non-continuous assessment: Students will make an exam with a number of questions and problems (analysis and/or synthesis) on specific aspects of the full course syllabus, covered by the theory, problems and laboratory classes, and providing 80% of the final score. The laboratory score will provide the additional 20% to calculate the final course score. Students that did not pass the laboratory assignment in the ordinary evaluation will have a specific theoretical and practical test to demonstrate the acquisition of the corresponding skills. The criteria to pass the course will be the same than in the ordinary evaluation.

GRADING CRITERIA

This section quantifies the grading criteria to pass the course.

Next we show, for every evaluation type, tables describing the relationship between the evaluation instruments, the evaluation criteria, the learning results and skills, as well as the grading percentage assigned to each evaluation instrument

Ordinary evaluation, continuous evaluation

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Grading score
TR2, TR8, CT11	RA1-RA6	CE1-CE3, CE5,CE6	ACTP, ACTNP	15%
			PEI	25%
			PEF	40%
TR2, TR8, CT1, CT3, CT11	RA1-RA4,RA7	CE1-CE6	PL	20%

Ordinary evaluation, non-continuous evaluation (final evaluation)

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Grading score
TR2, TR8, CT11	RA1-RA6	CE1-CE3, CE5,CE6	PEF	80%
TR2, TR8, CT1, CT3, CT11	RA1-RA4,RA7	CE1-CE6	PL	20%

Extraordinary evaluation

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Grading score
TR2, TR8, CT11	RA1-RA6	CE1-CE3, CE5,CE6	PEF	80%
TR2, TR8, CT1, CT3, CT11	RA1-RA4,RA7	CE1-CE6	PL	20%

RATING POLICY IN CASES OF PLAGIARISM

If a student is found to have copied / plagiarized, in any intermediate tests, final exam, exercises and/or laboratory assignment, and the evidence is clear, she/he and all the other students involved, will be automatically assigned a 0 score. Depending on each case, further disciplinary actions may be required to be carried out by the University, including the sanctions provided in the regulations.

6. BIBLIOGRAPHY

- Documentation generated by teachers for the course, which will be provided to students directly, or posted on the course Web site.
- Any of the following books covers the core content taught in units 1 through 4:
  - Electronic Circuits. Analysis and simulation design. Norbert R. Malik, Prentice Hall, London 1996. ISBN: 84-89660-03-4.
  - 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

- For unit 5:
  - Data acquisition subsystems. Fco Javier Rodriguez Sanchez, Francisco Javier Meca Meca and Emilio José Bueno Peña. UAH Publications Services, 1999. ISBN 84-8138-319-8.

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.