Universidad de Alcalá

# GUÍA DOCENTE

# CIRCUIT ANALYSIS (ANÁLISIS DE CIRCUITOS)

## Bachelor's Degree in Computer Engineering

## Universidad de Alcalá

**Academic Year 2019/2020**

**2nd Year - 2nd Semester**

# GUÍA DOCENTE

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|---|---|
| Subject: | **Circuit Analysis** |
| Code: | **590003** |
| Study: | **Degree in Computer Engineering** |
| Department: | **Teoría de la Señal – Ingeniería Eléctrica** |
| Type: | **Obligatory of specific technology** |
| Credits ECTS: | **6** |
| Course and semester: | **2nd Year - 2nd Semester** |
| Teachers: | **Ricardo Jiménez Martínez.**<br>**Philip Siegmann** |
| Tutoring schedule: | **Tuesday 15:00-17:00** |
| Language: | English |

## 1.a PRESENTATION

The current society demands the use of new information and communications technologies (ICT). These technologies require a series of electronic equipment and devices such as mobile phones, satellites or antennas. The design, optimization and maintenance of these equipment's require the knowledges of electrical phenomena and circuit analysis.

Requirements and recommendations:

In the course of Circuit Analysis complex mathematical concepts will be used. It is recommended that the students have some ability in solving mathematical problems, and, more specifically, using complex numbers and trigonometry, solving systems of linear equations, decomposition in simple fractions and using logarithmic and exponential functions.

## 2. Skills

### General skills:

CG8 Knowledge of basic materials and technologies that enable learning and development of new methods and technologies, as well as to equip them with great versatility to adapt to new situations.

CG9 Ability to solve problems with initiative, decision making, autonomy and creativity. Ability to communicate and transmit knowledge and skills of the profession of Technical Engineer.

### Specific skills:

CIC1 Ability to design and build digital systems, including computers, microprocessor-based systems and communications systems.

### Learning Outcomes:

1. RA1: Identify the key elements used to build electrical circuits, including their functionality and symbology.
2. RA2: Recognize the physical phenomena that occur in linear electrical circuits, particularly in sinusoidal steady state.
3. RA3: Apply the fundamental theorems of circuit theory to the analysis of any linear circuit in sinusoidal steady state.
4. RA4: Assemble prototypes of electric circuits and use the basic equipment's of any electronic circuits laboratory.

## 3. CONTENTS

| Blocks of contents | Total ECTS |
|---|---|
| **Module 1:** Basic concepts. Circuits fundamental laws. Working functions of the passive elements. Exercises. | • 0.9 ECTS |
| **Module 2:** Sinusoidal Steady State circuit analysis. Exercises. | • 0.8 ECTS |
| **Module 3:** Circuit's power supply (Generators). Exercises. Systematic circuit analysis. Exercises. | • 0.8 ECTS |
| **Module 4:** Fundamental theorems. Exercises. | • 0.6 ECTS |
| **Module 5:** Two-port Networks. Exercises. | • 0.4 ECTS |
| **Lab practices:** passive components, power source, function generator, multimeter and oscilloscope. Exercises. | • 2.5 ECTS |

## 4. TEACHING-LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

## 4.1. Credits distribution (specified in hours)

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|---|---|
| Number of on-site hours: | Theory 28 hours + Lab/practical exercises 28 hours + 4 hours of assessment |
| Number of hours for individual student work: | 90 hours including study, exam preparation and activities. |
| Total hours: | 150 hours |

## 4.2. Methodological strategies, materials and didactic resources

| | |
|---|---|
| • Theoretical lectures in large groups up to 50 students | • Recommended bibliography and notes. |
| • Small groups (up to 25 students) for solving practical exercises of the theoretical concepts. | • Collection of exercises and bibliography. |
| • Lab sessions for experimentation of the theory and exercises by performing real electrical measurements on real circuits (small groups up to 25 students). | • Manual for the lab practicums,<br>• Bibliography and notes. |
| • Students assistance with individual and/or group tutorials. | |

The teaching strategy of the course is divided into 3 sections: classroom learning, learning in small groups and finally the working sessions in the laboratory.

**Sessions of large group in the classroom:**

Working sessions in the classroom, in large groups, will consist of lectures where the main concepts of the theory of circuits will be presented.
The aim is to introduce students to the theoretical foundations of circuit analysis in a guided and reflective way. The understanding of these concepts will be enhanced in the small learning group with a more individualized assistance, by promoting both autonomous and grouped resolution of practical exercises and, also, with real experimentation in the lab. Teaching materials will be essential to create reflective learning environments, where students and teachers can undertake a critical analysis that allows the student to autonomously relate concepts.

The order of presentation of the contents will evolve from the simple to the complex, in order to avoid a high degree of abstraction that might cause a student lack of interest in the course. In any case, it is very convenient, during the working sessions in the classroom, to establish linkages with other subjects in the curriculum, and to provide possible experience on the contents, which will help to attract students' attention and will encourage their interest in the subject.

**Sessions of small groups:**

In the small groups of problems, our aim is to create participatory working environments. The students will solve theoretical problems with their peers, putting into practice the concepts covered during training sessions in the classroom. Student participation is essential, so we will use strategies to promote it (e.g. rounds of questions, debates, etc.). Our aim is to complete the teaching-learning process of the student, bringing he to the assimilation of concepts and their applications. We will emphasize that the analytical techniques must be considered as tools, not as goals. The strategies to adopt in these sessions are intended to promote the student habits when faced with solving a problem, namely: initial study of the circuit, choosing the best strategy for solving and critical evaluation of the results.

Information and Communications Technologies can also be used for supporting some of the training activities (Internet, forums, wikis and email, available materials in e-learning platforms, etc.).

**Laboratory sessions:**

Laboratory sessions comprise the third and final learning stage. The working sessions will be conducted in small groups, in which the student must work with her peers. The goal is that the student explores, with the help of a practical manual designed for the course, the applicability of the concepts of circuit theory. To this end, the methodology will be as follows.

Before each laboratory session, the student must practice in virtual format, it will use the software that is considered most appropriate and which can be downloaded for free from the corresponding website. At the beginning of each session the student must submit the virtual practice done and that will serve as support for the realization of the practice in the laboratory.

In the lab, students will work in groups of 2 or 3 people. When the practice exercise finishes, the students must deliver to the teacher a report that collects the measures and work performed.

## 5. ASSESSMENT

Assessment Procedures:

The student has two calls to pass the course, an ordinary and an extraordinary one. According to the regulations of the evaluation processes of learning – Consejo de Gobierno of March 24, 2011 - the evaluation will be continuous throughout the semester, except in the cases and conditions specified in that legislation, where it will be held by a final test.

**a) Continuous assessment:**

Given the importance of this course in most of the subjects of subsequent courses in the degree of electrical engineering, the assessment should not only ensure that the student has obtained the main concepts of circuit theory, but that he has reached

sufficient skills to be able to extrapolate that knowledge to the problems that students will find in the subjects mentioned.

Thus, it will be necessary to emphasize the educational nature of the continuous assessment described here. Since the main skills pursued by this course are related to the ability to analyze and solve problems by applying the theoretical concepts studied, the assessment will use instruments based on objective test of different types: problem solving and written tests focused on theoretic arguments.

In the small groups, it will be necessary to distinguish between the classes devoted to the laboratory, and those dedicated to solving problems. In the laboratory, some of the pursued skills are different from those pursued in the large groups, so the evaluation and the grading criteria for this part will be described later in this section of the document.

For small groups of solving problems, apart from the instruments mentioned above, other evidences will be used, such as:

- An analysis of the work of the students in not on-site hours.
- The observation of proactivity in resolving problems.
- Participation in the group.

**Assessment of the exercises of the laboratory:**

As mentioned above, the tools described in this section will be used in evaluating the specific laboratory skills.

Given that the main skill pursued in this block of the course is to acquire the capacity and ability to manage the laboratory instruments, the assessment will be based mainly on a systematic observation, both during the development of the practice sessions and the realization of the final test.

Also, given that the laboratory methodology is based on the realization of a daily practice, it will be necessary, for the proper monitoring of the continuous assessment, the delivery of a memory after every practice.

**b) Final assessment:**

For those students who do not opt for continuous assessment, as stated in the regulations governing the processes of learning assessment, the assessment will be to carry out the following tests and activities:

- Making a final test, consisting in solving a number of problems in a given time.
- Making a final test of the laboratory.

To qualify for the final evaluation, the student must apply in writing to the dean or director of the center in the first two weeks of teaching of the subject, explaining why he/she is refusing to follow the continuous assessment system. For students who have no formalized its enrollment to the course due to justified grounds, the mentioned deadline starts since they join the degree. The dean or center director must assess the circumstances cited by the student and make a reasoned decision.

After 15 days, if the student has not received any written response to his/her request, it is deemed to have been dismissed.

**c ) Extraordinary call:**

The extraordinary call will consist of performing a single final exam, which will consist in solving a number of problems in a given time. Whatever the outcome of this test, students must have successfully completed the lab practices in the ordinary call, as described in the previous section.

In any case, the partial results, which the student may have obtained in the continuous assessment part of the ordinary call, will not be taken into account.

## Evaluation criteria:

After having taken the course, the student should have acquired the following knowledge and skills:

- CE1: The student is able to analyze and understand the operation of any linear circuit, regardless of the nature and complexity of it.
- CE2: The student understands and is able to handle the equipment of a laboratory electrical measurement.
- CE3: The student acquires skills to search for information and to coordinate with other partners to solve the proposed activities in small group sessions, in the laboratory, or when working outside the classroom.
- CE4: The student is able to express the resolution of a problem in a clear way, orderly, and always following the correct nomenclature and formulation.

## Grading tools:

In this section we specify the grading tools to be applied to each of the evaluation criteria.

- Midterm Evaluation Test (PEI): Consist in solving the following problems involving the application of basic concepts:
    - PEI1: Solve DC and AC circuits.
- Delivery of Practical problems (EP): Delivery of the resolution of the lab practice using Virtual Simulation previous to the corresponding lab sessions.
- Lab practices (PL): Consisting in the set-up of an electrical circuit and performing measurements on it.
- Final Evaluation Test (PEF): Consisting in the resolution of exercises where all the studied concepts are applied with special attention to the last learned modules 3, 4 and 5.

## Grading Criteria

For each type of the evaluation calls, the relationship between the evaluation criteria, the tools and the grading is as follows.

**Ordinary call, Continuous Assessment**

| Skill | Learning outcome | Evaluation criterion | Grading tool | Contribution to the final mark |
|---|---|---|---|---|
| CG8, CG9 | RA1, RA2 | CE1, CE4 | PEI1 | 40% |
| CIC1 | RA1, RA2 | CE3 | EP | 8% |
| CG9, CIC1 | RA4 | CE2 | PL | 12% |
| CG8,CG9 | RA2, RA3 | CE1, CE4 | PEF | 40% |

**Ordinary call, Final Assessment**

| Skill | Learning outcome | Evaluation criterion | Grading tool | Contribution to the final mark |
|---|---|---|---|---|
| CG9, CIC1 | RA1, RA4 | CE2 | PL | 20% |
| CG8, CG9 | RA2, RA3 | CE1, CE2, CE4 | PEF | 80% |

**Extraordinary Call**

| Skill | Learning outcome | Evaluation criterion | Grading tool | Contribution to the final mark |
|---|---|---|---|---|
| CG9,CIC1 | RA1, RA4 | CE2 | PL | 20% |
| CG8,CG9 | RA2, RA3 | CE1, CE2, CE4 | PEF | 80% |

It is required to pass the course, in any of the types of assessment, to pass the laboratory evaluation (1 point over 2) and pass module 5 and 6 evaluation in the final exam (1 point over 4).

## 6. BIBLIOGRAPHY

Bibliografía Básica


- López-Ferreras, F., Maldonado-Bascón, S., Rosa-Zurera, M.. "Análisis de Circuitos Lineales", Editorial Rama.


Bibliografía Complementaria (optativo)


- Bruce Carlson: "Teoría de Circuitos". Ed. ITES Paraninfo


English bibliography:


- Van Valkenburg, M. E., Network Analysis - 3rd Edition. Prentice-Hall, 1974.
- Balabanian, N., Fundamentals of circuit theory, Allyn & Bacon, 1961.
- Desoer C.A. and Kuh, E.S., Basic Circuit Theory, McGraw-Hill, 1966.