Universidad de Alcalá

TEACHING GUIDE

Circuit Analysis

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

Universidad de Alcalá

Academic Year 2022/2023

1st Year - 2nd Semester (GITT+GIST+GIT+GIEC)

Approved by the School Board on June 3, 2022

TEACHING GUIDE

Course Name:	**Circuit Analysis**
Code:	**350005 (GITT+GIST+GIT+GIEC)**
Degree in:	**Telecommunication Technologies Engineering (GITT)** **Telecommunication Systems Engineering (GIST)** **Telematics Engineering (GIT)** **Electronic Communications Engineering (GIEC)**
Department and area:	**Teoría de la Señal y Comunicaciones** **Signal Theory and Communications**
Type:	**Compulsory (GITT+GIST+GIT+GIEC)**
ECTS Credits:	**6.0**
Year and semester:	**1st Year - 2nd Semester (GITT+GIST+GIT+GIEC)**
Teachers:	See Webpage
Tutoring schedule:	To be published at the beginning or the term
Language:	English

1. COURSE SUMMARY

The subject of Circuit Analysis is a continuation of the subject of Circuit Theory given in the first semester of the first academic year. The purpose of Circuits Analysis is to conclude the basics knowledge necessary for analysing electrical circuits that has been given in first semester and, at the same time, a more abstract point of view is used to analyse the networks by modelling them in a more general way and by using certain transforms for their resolution. Also, the basics for understanding information transmission are studied.

More specifically, the transient response of circuits and their response with varying frequency are studied. In addition, the behaviour of the passive components, and their influence and application for filtering selective information is analysed. Furthermore, the circuits are modelled by his external behaviour in the time as well as in the frequency domain, where the concept of analogical filtering is introduced as a key concept for the electrical systems.

Previous knowledge acquired in the first semester that the students should have to better understand and successfully accomplish Circuits Analysis are:

- From Circuit Theory it is essential to know how to analyse a circuit in direct current (DC) as well as in sinusoidal steady state regimen, the theorems of Thevenin and Norton, and to operate with complex numbers.
- From Calculus I and Lineal Algebra the students should have acquired the knowledge of how to solve linear differential equations and some experiences with Laplace transforms.

The concepts given in Circuit Analysis will be fundamental in the study and comprehension of the following courses related with electronic, signals and systems, and wave propagation.

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_TRU2 - Oral and written competencies.

en_TRU4 - Autonomous learning skills.

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_CT4 - Skills for analyze and specify the fundamental parameters of a communications systems.

Learning Outcomes

After a successful completion of the course the students will acquire the following learning outcomes and be able to:

RA1. Determine the transient response of the circuits.

RA2. Characterize the circuits as functional blocks described by their electrical behavior at their terminals.

RA3. Understand the behavior of the circuits from the point of view of signal transmission systems.

RA4. Determine the frequency behavior of the circuits when applied as filters and tunable circuits.

3. CONTENTS

Contents Blocks	Total number of hours
Block 1. Analysis of the circuit's transient response. Analysis in the time and in the Laplace transform domain.	13 hours
Block 2. Two-port networks. Family of parameters: concepts, physical understanding and applications. Association of two-port networks.	12 hours
Block 3. Everitt Theorem and maximum power transfer. Transmission and insertion loss. Image parameters of a two-port network.	10 hours
Block 4. Introduction to passive filters. Transfer function and frequency response. First and second order functions. Tunable circuit analysis. Resonance frequency and quality factor of a circuit.	15 hours

Laboratory	Total number of hours
Experiment 1. Analysis and visualization of transient phenomena.	2 hours
Experiment 2. Two-port networks measurement and parameters calculation.	2 hours
Experiment 3. Measurement of passive LC filters frequency response.	2 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours in class + 2 hours for examinations)
Number of hours of student work:	92 hours (Study of theoretical concepts, related activities and preparation for examinations).
Total hours	150

4.2. Methodological strategies, teaching materials and resources

The teaching strategy is divided in two parts: Small group learning sessions and master classes in large groups.

Master classes in large groups:

The master classes will be oral expositions of the theory where the most important concepts are exposed. They will be supported by the traditional blackboard and summarized slides. The aim is to introduce the student into the basic theoretical concepts of circuits analysis in a guided and reflexive way. The assimilation of the concepts will be done through the resolution of practical problems by the student, although some of them will be solved during the small group learning sessions. The students will have teaching material such as the slides and large number of exercises for facilitate a reflexive learning.

It is of special interest to show the students the relationship of what is being taught with subjects that are or will be used in other courses of the degree.

Small group learning classes

In the small group learning classes the theory will be applied in form of exercises on practical problems. It is the aim to promote participative working groups in which the student has to actively participate. This will help to follow the teaching-learning process. The teacher will show how to solve the problems and may use different strategies such as the resolution of problems by group learning, discussions and analysis of the results, etc. There will be also occasional evaluations, co-evaluations or auto-evaluations of problems previously solved by the students at home or in class.

Technologies of the information and communication can also be used to support the training activities (forums, email's of the teacher, slides, bibliography, exercises, etc. are available through a virtual platform of the subject).

Laboratory

The laboratory sessions will allow to reinforce and visualize the concepts taught in the theory and, in addition, to review the use of laboratory instrumentation that was already used in previous subjects such as Circuit Theory.

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.

Ordinary call

Continuous evaluation:

Because the principal competencies we seek in this subject is the capacity to analyse and solve problems by applying the studied theoretical concepts, the evaluation will use instruments different kind of instruments for objective examinations, mainly the resolution of short problems and of written questions based on theoretical reasoning.

Different assessment instruments will also be used to assess each student's class work given the importance of continuous learning.

In addition, the work carried out in the laboratory will be evaluated in order to show the practical application of the theoretical concepts studied.

Final Evaluation:

For the students that do not follow a continuous evaluation, the evaluation will consist in performing a final examination consisting on solving several problems within a given time and the work done in the laboratory will also be assessed in the same way as students who follow continuous assessment.

Extraordinary call

The extraordinary examination consisting of solving several problems within a given time. In any case, the partial results corresponding to the continuous evaluation that the student may have obtained in the ordinary examination, will not be taken into account.

5.2. EVALUATION

EVALUATION CRITERIA

The evaluation criteria assess the extent to which the student have acquired the competencies. For this propose the following criteria are defined:

CE1. The student has acquired technical knowledge about electrical circuits in aspects related to their behavior in transient response, their frequency response and their characterization as functional blocks.

CE2. The student is able to express the solution of a problem in a clear and ordered way, and following the correct nomenclature.

GRADING TOOLS

The grading instruments used for the assessment of each of the evaluation criteria are:

- **Interim Evaluation Tests (PEI-1 and PEI-2)** consisting of solving several tests and/or problems of practical application of the basic concepts. The PEI-1 will be done in the middle of the semester and will correspond to blocks 1 and 2 of content. The student who does not do this test will be graded with of '0 points' in this part. On the date reserved for the final exam, at the end of the term, all students will do the PEI-2 corresponding to blocks 3 and 4 of content. Students will also have the opportunity to improve their initial PEI-1 score.
- **Final Evaluation Test (PEF)**.For students following the Final Evaluation, the final exam will consist of two midterms (PEI-1 and PEI-2) done together. The student that do not do this Final Evaluation Test will be graded with 'No Presented' in the subject of Circuit Analysis.
- **Class work (TC)**. This class work will be evaluated through the delivery of solved problems and the individualized follow-up of each student. To obtain this qualification it is necessary to attend at least 80% of the classes in a small group.
- **Laboratory (LAB)**. The laboratory will be evaluated by the previous work carried out before the laboratory sessions, by means of the presentation of results reports and by the follow-up in the

performance of the laboratory experiments. It is necessary to carry out all the programmed experiments in order to obtain the score in this section.

GRADING CRITERIA

For each of the examination calls the relation between the evaluation criteria and grading instruments for each of the learning outcomes is as follows:

Ordinary continuous evaluation call

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TRU2, TRU4, CT1, CT4	RA1, RA2	CE1, CE2	PEI-1	40%
TR2 TRU2 , TRU4, CT1, CT4	RA2, RA3, RA4	CE1, CE2	PEI-2	40%
TR2, TRU4, CT1, CT4	RA1, RA2, RA3, RA4	CE1	TC	10%
TR2, TRU4, CT1, CT4	RA1, RA2, RA3, RA4	CE1	LAB	10%

The student will pass the subject if obtains a global grading equal or higher than 5 points.

Students who want to improve the grade on the PEI-1 should note that if the new grade is greater than the grade earned previously, that improvement will be reflected in the grade on the PEI-1, but if the new grade is lower, the grade on this test will be the average of the two grades earned.

Ordinary final evaluation call

For the ordinary final evaluation call a Final Examination Test will be done that accounts for 90% of the grading of the subject (9 points), being the rest obtained in the laboratory experiments previously described. In the ordinary call with no continuous evaluation, the relation between the evaluation criteria and grading instruments for each of the learning outcomes is as follows:

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TRU2, TRU4, CT1, CT4	RA1, RA2, RA3, RA4	CE1, CE2	PEF	90%
TR2, TRU4, CT1, CT4	RA1, RA2, RA3, RA4	CE1	LAB	10%

Extraordinary call

In the extraordinary examination call, the students that have not passed the ordinary evaluation call will do one exam that accounts 100% of the grading of the subject. The relation between the evaluation criteria and grading instruments for each of the learning outcomes is as follows:

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TRU2, TRU4, CT1, CT4	RA1, RA2, RA3, RA4	CE1, CE2	PEF	100%

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- F. López Ferreras, S. Maldonado, M. Rosa: “Análisis de circuitos lineales”. Ed. Ra-ma.

6.2. Additional Bibliography

- Balabanian, N. and Bickart, T. A., Seshu, S., Teoría de Redes Eléctricas. Editorial Reverté, 1969.
- Van Valkenburg., Análisis de Redes. Editorial Limusa, 1982.
- Guillemin, E.A., Introducción a la Teoría de Circuitos. Editorial Reverté, 1959.
- Nilsson, J. W., Circuitos Eléctricos. Cuarta edición. Editorial Adisson-Wesley, 1995.
- Gómez Expósito, A. Fundamentos de teoría de circuitos. Thomson, 2007.

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.

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.