Universidad del País Vasco — Euskal Herriko Unibertsitatea

COURSE GUIDE 2025/26

Faculty 345 - Faculty of Engineering - Bilbao **Cycle** .

Degree GITECI30 - Bachelor`s Degree in Industrial Technology Engineering **Year** Second year

COURSE

27310 - Analysis of Electrical Circuits **Credits, ECTS:** 6

COURSE DESCRIPTION

The objective of this course is to establish both the language and the basic principles of Circuit Theory within the framework of electrical engineering.

These principles are rooted on physical and mathematical fundamentals that have already been learned, such as electromagnetism and vector calculus.

In turn, these will allow the student to understand and interpret new concepts developed in other subjects of the area such as: Electrical Machines, Electrical Technology, Low Voltage Systems, Protection Systems, Planning and operation of electrical systems, etc.

All the elements of the electrical power system, e.g. generation technologies, transport, distribution and consumption systems, can be analyzed with the help of the tools and concepts spelled out in this course.

It is therefore essential for an engineer to be able to handle and comprehend the different variables that come into play when dealing with any electrical device (generators, motors, power lines, wind turbines, solar panels, etc.), as well as the electrical principles and laws that relate them.

Learning the concepts of this course enables the student to understand the characteristics of electrical installations and their equipments, to develop the skills to analyze responses to specific problems, as well as to seek solutions before new challenges and to write reports containing proper and reasoned contributions.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

This subject will allow to strengthen the following general competences of the grade:

G003: Knowledge in basic and technological subjects, that enables the student to learn new methods and theories, and gives him/her versatility to adapt to new situations.

G004: Capacity to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge and skills in the field of Industrial Engineering.

From the specific competence (M02R4) of the module in which the subject is located (M02 - common to the Industrial Branch):

M02R4: Knowledge and use of the principles of Circuit Theory and Electrical Machines.

Complete mastery of the subject will afford the following Capacities:

C1: To master and to handle with precision the language and concepts related to the Electrical Circuits.

C2: To understand, to apply and to interrelate the different laws, methods and concepts involved in the analysis of the response of electrical circuits, in steady state.

C3: To know how to correctly interpret the data of a problem, so that, from them, it can be correctly analyzed.

C4: To choose the appropriate method for the analysis of a proposed circuit.

C5: To identify the correct solution, and to accurately calculate the different variables under study.

C6: To express the solutions accompanied by the appropriate units and framed within the appropriate ranges of magnitude.

Theoretical and Practical Contents

UNITS

UNIT 1 Introduction to Circuit Theory

UNIT 2 Analysis of steady state single-phase circuits
UNIT 3 Network theorems
UNIT 4 Matrix methods for circuit analysis
UNIT 5 Analysis of steady state three-phase circuits
UNIT 6 Analysis of transient circuits

LABORATORY PRACTICES

Four sessions will be held with contents adapted to the material taught along the course

TEACHING METHODS

The teaching methodology followed is based on these four axes:

1.- Using a weekly lecture the concepts to work throughout the week are set. These concepts are developed in situ on the board, supported by the use of slides. The student must complement the material provided with detailed explanations developed in class.

2.- In classroom practice sessions, on a weekly basis, the professor works out a number of problems that illustrate the concepts previously presented in the lecture. By showing how to address the problems through analytical and deductive reasoning the student builds up interrelationships between laws, variables and methods of circuit analysis. Moreover, the student gets used to be exhaustive in the correct use of language (phasor terminology, units, polarities, variable naming, etc.) becoming more autonomous when it comes to solving new problems that are presented in seminar classes.

3.- Throughout eleven seminars the students, grouped in small teams, address the challenge of solving more general problems which progressively incorporate everything learned, both in lectures and classroom practices. The lecturer guides the class ensuring that the whole class performs at the same pace and that at the end of the session all groups have completed and understood all aspects of the problem posed.

4.- The four laboratory sessions, interspaced in the weeks free of seminars, are aimed to illustrate, through ad hoc assemblies, fundamental aspects of the subject, incorporating the use of measurement equipment confronting the student with the physical circuits. The use of sources, loads, series and parallel connections, three-phase circuits, measurement devices, etc., complements and cements the previously learned contents which were of a more theoretical nature. In addition, elaborating reports that incorporate theoretical explanations and calculations of measurements observed in the laboratory increases their skills to write reasoned reports with the appropriate terminology to this matter.

Finally, relying on a virtual platform, the student is provided with both the material used in class and collections of tests in order to facilitate self-assessment. Any of the activities carried out in both presential and non-presential manner, have the possibility of being reinforced through tutoring either individually or in small groups with the selfsame teachers in charge of teaching the group.

In case that health situation prevent the performance of any teaching activity and/or on-site evaluation, another kind of modality will be activated of which the students will be informed promptly.

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	22,5	16,5	15	6					
Horas de Actividad No Presencial del Alumno/a	33,75	24,75	22,5	9					

Legend:
M: Lecture-based
S: Seminar
GA: Applied classroom-based groups
GL: Applied laboratory-based groups
GO: Applied computer-based groups
GCL: Applied clinical-based groups
TA: Workshop
TI: Industrial workshop
GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- EVALUATION-SYSTEM DEPENDENT TOOLS 100%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

CONTINUOUS EVALUATION SYSTEM

In this system the evaluation consists of three blocks:

Block A
By means of an exam the student must show the acquired knowledge. The weight of this block corresponds to 70% and is evaluated in the called examination.

Block B
Through problem solving, either in teams or individually, the students must show their mastery of the subject. The weight of this block corresponds to 20% and is evaluated through short reports that will take into account the work done during the seminar sessions. This block can also be evaluated by individual specific tests.

Block C
Through real setups in the laboratory, and in contrast to the theoretical part studied, the student must show and put into practice the knowledge acquired. The weight of this block corresponds to 10% and is evaluated through short reports that will take into account the work done during the laboratory practice sessions. This block can also be evaluated by individual specific tests.

In order to pass the subject according to this system, the student must demonstrate that he/she has achieved the expected learning results by obtaining a grade in each of the blocks (Block A, Block B and Block C), the grade obtained in each of them being higher than or equal to 40% and also such that the weighted average of each block is greater than or equal to 50% of the total. Students who do not pass the minimum mark in any of the three blocks indicated will have a maximum final mark of 4.

FINAL EVALUATION SYSTEM

The student will be able to opt for the final evaluation system whenever he formally requests it to the teacher before the 10th week of the semester.

In this system the evaluation consists of two blocks:

Block D
By means of an exam the student must show the acquired knowledge. The weight of this block corresponds to 90% and is evaluated in the called examination.

Block E
By means of an exam the student must show the knowledge acquired in the laboratory. The weight of this block corresponds to 10% and is evaluated in the called examination.

In order to pass the subject according to this system, the student must demonstrate that he/she has achieved the expected learning results by obtaining a grade in each of the blocks (Block D and Block E), the grade obtained in each of them has to be greater than or equal to 50 % and, moreover, the weighted average of each block must be equal to or greater than 50% of the total.

Students who do not pass the cut mark in any of the two blocks indicated will have a maximum final mark of 4.

In both evaluation systems, in order to relinquish the ordinary call, it is enough not to take part in the evaluation exams called on the official dates of the mentioned examination.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The evaluation in the extraordinary call is identical to the evaluation in the ordinary call, and therefore the student must choose between the continuous evaluation system or the final evaluation system:
- For the continuous evaluation system of the extraordinary call, the obtained marks of any of the blocks A, B or C in the continuous evaluation system of the ordinary call may be kept, upon request, as long as they are equal to or greater than the established cut mark (40%).
- For the final evaluation system of the extraordinary call, the obtained marks of any of the blocks D or E in the final evaluation system of the ordinary call may be kept, upon request, as long as they are equal to or greater than the established cut mark (50%).

In the case that the student comes from the continuous evaluation system of the ordinary call, the following marks can be validated upon request:
+ The mark of block E for that of block C, when it had been equal to or greater than 50%
+ The mark of block D for the weighted sum of the marks in blocks A and B, when each of them had been equal to or greater than 40% and the aforementioned weighted sum is equal to or greater than 50%.

The student will be able to choose for the final evaluation system whenever they formally request it in advance to the teacher. That must be done at least one week before the official published date of the call.

In order to waive the extraordinary call, it is enough not to attend the evaluation exams that are called on the official dates of the mentioned call.

MANDATORY MATERIALS

Course notes, exercise collections and past exams are published in the virtual platform

BIBLIOGRAPHY

Basic bibliography

(english)
Alexander C. and Sadiku M., Fundamentals of Electric Circuits (4/e), McGraw-Hill 2008

(spanish)
Fraile Mora, J., Circuitos Eléctricos, Prentice Hall, 2012, ISBN: 9788483227954, 576 pages

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Sanjurjo Navarro, R.,"Zirkuitu elektrikoen teoria", EHUko Argitalpen Zerbitzua, 2005
ISBN: 84-8373-820-1

Detailed bibliography

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Alexander C. and Sadiku M., Fundamentals of Electric Circuits (4e), McGraw-Hill 2008
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Van Valkenburg, M. E, Network analysis, Prentice Hall Electrical Engineering Series 1964

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Bruce Carlson, A., "Teoría de Circuitos", Ed. THOMSON, 2002, ISBN: 84-9732-066-2.
Charles K. Alexander, Matthew N. O. Sadiku, Fundamentos de circuitos eléctricos, 5/e, McGraw-Hill Interamericana de España S.L., 2013, ISBN-13: 978-607-15-0948-2
Conejo Navarro, A.J. et al., Circuitos Eléctricos para la ingeniería, McGraw Hill, 2004, ISBN:84-481-4179-2, 405 páginas
Dorf R.C. y Svoboda J. A., "Circuitos eléctricos. Introducción al análisis y diseño", 3ª ed., Marcombo, 2000, ISBN: 8426712711.
Hayt W., Kemmerly J., Durbin S., Análisis de circuitos en ingeniería, 8ª ed., McGraw-Hill Interamericana de España S.L., 2012, ISBN-13: 978-6071508027
López Ferreras, F., Análisis de Circuitos Lineales. Vol. I y II, 2ª ed., Ed. Ciencia 3, Madrid, 1994, ISBN: 849539183X, 392 páginas
Madrigal, R.I., "Teoría Moderna de Circuitos Eléctricos", Ed. Pirámide. 1977.
Parra Prieto, V. et al., Teoría de Circuitos. (V 1 y 2), 7e., UNED., Madrid, 1997, ISBN: 843621949X, 1116 Páginas
Thomas L. Floyd, Principios de circuitos eléctricos, 8e., Prentice Hall, 2007, ISBN-13: 978-970-26-0967-4
Thomas, R.E., Rosa, A.J., Circuitos y Señales: Introducción a los Circuitos Lineales y de Acoplamiento, Ed. Reverté. 1991.

(basque)
Arbelaitz, O. eta Ruiz T., "Zirkuitu elektriko eta elektronikoen oinarrizko analisia", UEU, 2001, ISBN: 84-8438-018-1.

Journals

Web sites of interest

OBSERVATIONS

This english version of the teaching guide purports to be a faithful translation of the original spanish GUIA DOCENTE document. Should any inexact or unclear statement remain, the original GUIA DOCENTE will prevail.

During the exams, the use and possession of mobile phones as well as of any other communication device (be it electronic, mechanical, optical, etc.) is strictly forbidden. Break this rule entails a no pass mark in the corresponding call.