

**COURSE DATA****DATA SUBJECT**

Code: 34927
Name: Principles of electrical engineering and electronics
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1404 - Degree in Industrial Electronic Engineering	Escola Tècnica Superior d'Enginyeria	1	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1404 - Degree in Industrial Electronic Engineering	Foundations of electrotechnics and electronics	COMPULSORY

COORDINATION

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SUMMARY

This course is part of the "Fundamentals of Electrical Engineering and Electronics" subject of the Degree in Industrial Electronics Engineering, a common block in the branch of Industrial Engineering. The aim is to acquire knowledge and use the principles of circuit theory and an introduction to electrical machines.

It is a fundamental and technological subject, and its great importance lies in the fact that it is the first subject of electrotechnical/electronic content in the degree. For this reason, the objectives of the subject are, on the one hand, to provide students with the basic knowledge of electricity and the analysis of electrical circuits (what is known as circuit theory) and, on the other hand, to introduce them to electrical machines.

The objective is ambitious, and the contents are developed without going into too much depth but without renouncing the required rigor. In this subject, an introduction to electrical circuits is given, acquiring the basic notions of circuit theory. It will also introduce the classification and operating principles of electrical machines.



The contents of the course are:

Basic concepts of circuits. Elementary analysis of direct current circuits. Circuit simplification tools. Transient and steady state. Concept of power. Sinusoidal alternating current circuits in permanent regime. Transfer functions, frequency response and system stability. Laplace transform for circuit analysis. Introduction to electrical machines.

The course's main objective is for students to gain a detailed and in-depth knowledge of an essential element for the rest of their training as industrial electronics engineers: the analysis of electrical circuits. At the end of the course, students should be able to handle with ease the different mathematical tools taught during the course to solve electrical circuits using various approaches. Likewise, they must discern which method is the most suitable among all those they know to solve a given circuit.

In particular, the objectives pursued and to be achieved by the student are the following:

- Know the basic concepts of current and voltage sources, and the basic passive devices from the point of view of circuit theory, being able to characterise them according to the working regime or the mathematical method used for their analysis, both in direct and alternating current or other sources of excitation.
- Know the concepts of phasor and impedance.
- Master the different algebraic forms of phasor representation, equivalence between them, and correspondence with sine functions in the time domain.
- Assimilate Kirchhoff's laws in the complex domain.
- Know power and energy concepts and their application in network theory.
- Learn the fundamental laws of electrical circuits and knowing how to apply them to solve circuit problems using the most straightforward or most appropriate path in each case.
- Learn the main tools and theorems for simplifying and solving circuits.

Learn the general principles of electrical machines. Introduction to static (transformer) and dynamic (synchronous, asynchronous and direct current machines) electrical machines.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

No enrolment restrictions have been specified for other subjects in the syllabus.

Other requirements:



There are no prerequisites in Electronics or Circuit Theory, although it is advisable for students to be familiar with some physical concepts and the use of some of the mathematical tools that will be used during the course in order to be able to tackle the subject with a guarantee of success. In particular, students should meet the following mathematical requirements:

Fluency in mathematical calculations with complex variables.

Fluency in vector calculus.

COMPETENCES / LEARNING OUTCOMES

1404 - Degree in Industrial Electronic Engineering

CG21 - Knowledge and use of the fundamentals of circuit theory and electric machines.

CG22 - Knowledge of the fundamentals of electronics.

CG3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.

CG4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering (with specific industrial electronics technology).

CG5 - Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and analogous work.

CG6 - Ability to deal with specifications, regulations and mandatory standards.

DESCRIPTION OF CONTENTS

1. Electrical Circuits and electrical machines

1. Concept of invariant linear circuit with localised parameters. Voltage and current. Ohm's law. Impedances. Basic elements: resistance, capacitor and coil. Association of elements: Series and parallel circuits. Voltage and current generators Waveforms: properties.
2. Kirchhoff's laws. Concept of knots, branch and mesh. Law of knots. Lattice law.
3. Energy and power in an electrical network. Concept and units. Passive and active elements. Energy balance in an electrical network. Examples.
4. Network theorem: superposition, Thévenin, Norton. Examples. Maximum power transfer.
5. Analysis using differential equations: causal systems. Time response of linear circuits. Free and forced response, transient and steady state. Natural and step response of linear systems type RL, RC, and RLC.
6. Stationary sinusoidal regime. Fundamentals. Phasors. Complex electrical quantities. Alternating current.
7. Power and energy in the steady-state sine wave regime: active, reactive, apparent and complex power. Power triangle. Boucherot's theorem. Power factor.
8. Transfer function and frequency response. Representation in logarithmic scales. Decibel. Bode



diagrams: definition and purpose. Real zeros and poles. Complex zeros and poles Resonances Damping. Examples.

9. The Laplace Transform in network analysis. Definition, properties and usefulness. Basic impedances. Analysis of nodes and meshes. Inverse transform.

10. Introduction to electrical machines.

2. Laboratory Practice

1. Direct current measurements. Ohm's Law. Multimeters. Resistance measurements. Voltage dividers. Impedance association. Power.

2. Network theorems I.

3. Network Theorems II.

4. Analysis of circuits by means of differential equations. Charging and discharging of a capacitor.

5. Measurements in alternating current. Oscilloscope and signal generators.

6. Frequency response. Study of basic filters.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Laboratory	20,00
Classroom practices	10,00
Total hours	60,00

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	0,00
Preparation of lessons	40,00
Preparation for assessment activities	30,00
Resolution of case studies	0,00
Total hours	90,00

TEACHING METHODOLOGY

The development of the course is structured in four learning modalities: theory and problem solving sessions, individual tutoring, and presentation of technical documentation accounting for the laboratory practices.

**Learning in group with the professor.**

The theory and problem sessions will use the model of master lesson. In the theoretical sessions the professor will explain the fundamental contents of the subject using audiovisual aids, such as presentations and blackboard. In the problem sessions, the lecturer will explain a series of problems-type, thanks to which the student will learn how to identify the essential problem elements and the best solution for each problem. These sessions will encourage the participation between students and students/professor (G3, G4, G5, G6, G21, G22).

Tutoring.

The students will have tutoring sessions whose purpose is solve problems, doubts, orientation in works, etc. The tutoring schedule will be indicated at the beginning of the academic course. Additionally, some punctual doubts would be clarified by email.

Working in groups in the classroom.

In the laboratory, the groups will be formed by a maximum of two students, which have to organise to make the design, mount the electronic components and perform the experimental tests. Each practice has a estimated length of 3 hours.

Available educational resources.

The student will have from the start of the academic course the following documents:

- **Educational Guide**, which offers the sufficient informative elements to determine the subject contents, structure and evaluation methodology
- **Theoretical material** of each one of the lessons
- **Problem sets.**
- **Guide notes for the laboratory sessions.**

EVALUATION

The assessment of the learning of the course follows the recommendations of the ETSE-AC2PI model, and is structured in the continuous assessment of the student in a weighted way in three parts:

Participation (10%, G3, G4). Attendance and participation in classes will be assessed through the performance of exercises by the student and group discussion of practical or theoretical aspects of the subject. The mark for this section will have a weight of 10% of the final mark.

Laboratory (30%, G4, G5, G6, G22). The laboratory mark, assessed on a continuous basis (throughout the course), will be obtained as a result of assessing each practical and a final practical exam, individual, of the same nature as the practicals carried out, which will take place in the laboratory during the last session of the practicals. The continuous assessment of each practical (preparation 30%, performance 70%) will constitute 40% of the final laboratory mark, while the remaining 60% will be obtained from the individual final exam, the minimum mark for which will be 4.



The laboratory mark obtained as described in the previous paragraph will represent 30% of the mark for the course. It will be essential to obtain a 4 out of 10 in this mark in order to obtain an average for the remaining parts of the assessment.

For students who do not obtain a mark of 4 or higher by attending the laboratories, there will be two further sittings on the dates and at the times officially designated by the centre for the official examination of the course, after the theory exam. The mark for this exam will represent 100% of the laboratory mark and 30% of the course mark, and it is essential to obtain at least a 4 out of 10.

Theory (60%, G3, G4, G21, G22). The final exam will be taken individually, written, and based on problems that assess the degree of acquisition of the proposed skills. The mark for this theoretical part will represent 60% of the total mark for the course.

A mark of less than 4 in any of the parts will result in a fail in the course.

A global mark greater than 5 must be obtained in order to overcome the course.

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA ([ACGUV 123/2020](#)).

REFERENCES

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- Irwin, J. D. Análisis básico de circuitos en ingeniería. Prentice-Hall, 1997.
- Soria, E.; Martín, J. D. y Gómez. L. Teoría de circuitos. McGraw-Hill (Serie Schaum), 2004.



- Espí, J.; Muñoz-Marí, J; Camps-Valls, G. Análisis de circuitos. PUV, 2006.
- José Espí-López, Gustavo Camps Valls, Jordi Muñoz Marí, Electrónica analógica. Problemas y Cuestiones, Pearson Educación 2006.
- Mazón, J. Guía de Autoaprendizaje de Máquinas Eléctricas. 2008, Prentice-Hall/Pearson Educación
- J. Fraile Mora. Máquinas Eléctricas. Sexta Edición. McGraw-Hill, Madrid, 2008. ISBN: 978-84-481-6112-5