Electrical power engineering fundamentals

Academic Year: (2024 / 2025) **Review date: 04-07-2024**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: ALONSO-MARTINEZ DE LAS MORENAS, JAIME

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

All first-year subjects. Among them, Calculus I, Calculus II and Physics II are of utmost importance.

SKILLS AND LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG2. Apply computational and experimental tools for analysis and quantification of energy engineering problems
CG4. Being able to do design, analysis, calculation, manufacture, test, verification, diagnosis and maintenance of energetic systems and devices.
CG10. Being able to work in a multi-lingual and multidisciplinary environment
CE11 Módulo CRI. Knowledge and use of the basic principles of electrical circuits and electric machinery theory.
CT1. Ability to communicate knowledge orally as well as in writing to a specialized and non-specialized public.
CT2. Ability to establish good interpersonal communication and to work in multidisciplinary and international teams.
CT3. Ability to organize and plan work, making appropriate decisions based on available information, gathering and interpreting relevant data to make sound judgement within the study area.
CT4. Motivation and ability to commit to lifelong autonomous learning to enable graduates to adapt to any new situation.

By the end of this content area, students will be able to have:
RA1.2 a systematic understanding of the key aspects and concepts of electrical circuits;
RA2.1 the ability to apply their knowledge and understanding to identify, formulate and solve electrical circuits problems using established methods;
RA4.2 the ability to design and conduct appropriate experiments, interpret the data and draw conclusions;
RA4.3 workshop and laboratory skills.
RA5.2 the ability to combine theory and practice to solve electrical circuits problems.

OBJECTIVES

By the end of this content area, students will be able to have:
1. A systematic understanding of the key aspects and concepts of electrical engineering;

2. Awareness of the wider multidisciplinary context of engineering.
3. The ability to apply their knowledge and understanding to identify, formulate and solve electrical engineering problems using established methods;
4. The ability to design and conduct appropriate experiments, interpret the data and draw conclusions;
5. Workshop and laboratory skills.
6. The ability to combine theory and practice to solve electrical engineering problems.

DESCRIPTION OF CONTENTS: PROGRAMME

Introduction to the Electric Power Engineering
Ideal- and real elements of circuits: resistance, inductance, capacitance, coupled inductances, voltage- and current sources.
Kirchhoff's laws.
Grouping of elements. Voltage and current divider.
Mesh and nodal analysis of linear circuits
Superposition principle. Thevenin's and Norton's theorems.
Symbolic computation by means of complex phasors.
Analysis of a.c. circuits
Balanced three-phase circuits
Fundamentals of electric power systems

LEARNING ACTIVITIES AND METHODOLOGY

This subject has a twofold objective. On one side, the spreading of a basic electrical engineering culture, including the proper use of the technical language and vocabulary used to describe electric circuits and systems. On the other hand, the explanation of theoretical foundations and practical methods of analyzing linear, lumped-parameters, dc and ac circuits.

Therefore, the methodology is a mix of theoretical lectures, that essentially involve a thorough and systematic application of Kirchhoff's laws, and practical, problem solving oriented activities. Simple problems will be solved manually, more complex ones will require the use of computer tools.

Classroom activities will be completed with three lab sessions, with a duration of two hours each, on measurements and safety rules, dc circuits, ac circuits and 3-phase circuits.

The use of the simulation software PSIM will also be included as a visual tool that provides inmediate feedback on key concepts, and as a tool for checking problem results.

ASSESSMENT SYSTEM

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

THINGS TO DO DURING THE COURSE REGARDING GRADES:

- There are 3 mandatory lab sessions during the course. EVERYBODY (no exceptions) has to pass an exam on the lab sessions at the end of the semester. Those who don't pass this exam won't be able to pass the course before the extraordinary call. You won't be able to go to the ordinary call.
- The students will take 3 partial exams during the course. Their continuous evaluation grade will be the average of those exams.

There are 3 opportunities to pass the course:

1) WITHOUT GOING TO THE FINAL EXAM:

The student does not need to sit the ordinary call exam if ALL the following conditions are fulfilled:
- The student has passed the lab exam
- The student has passed at least 2 out of 3 partial exams
- At least a grade of 3/10 in the first partial exam
- At least a grade of 4/10 in the second and third partial exams
- The average of the three partial exams is 5/10 or more

The course grade will be the continuous evaluation grade.

2) ORDINARY CALL: CONTINUOUS EVALUATION+FINAL EXAM:

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

- The ordinary call exam will have 2-4 exercises. Questions on lab sessions can be included.
- The exam grade is the weighted average of the exercises

Final course grade calculation:
- A minimum grade of 5/10 is required to pass.
- The final grade will be 40% continuous evaluation and 60% exam grade.
- If the student did NOT pass the lab exam the maximum final grade is 4/10.
- If the student gets less than 2.5/10 in any of the FINAL exam exercises, the maximum final grade is 4/10. This requirement does not apply to the partial exams, only to the final exam.

3) EXTRAORDINARY CALL: 2 options

- The extraordinary call exam will have 2-4 exercises. Questions on lab sessions can be included.
- The exam grade is the weighted average of the exercises
- A minimum grade of 5/10 is required to pass.
- If the student gets less than 2.5/10 in any of the extraordinary exam exercises, the maximum final grade is 4/10.

BASIC BIBLIOGRAPHY

- James William Nilsson Electric Circuits, Pearson, 2015

- Jesús Fraile Mora Electromagnetismo y Circuitos Eléctricos, McGraw-Hill, 2005

- Jesús Fraile More Circuitos Eléctricos, Pearson, 2012

ADDITIONAL BIBLIOGRAPHY

- Antonio Gómez Expósito Fundamentos de Teoría de Circuitos, Thomson, 2007

- Antonio Gómez Expósito Teoría de Circuitos - Ejercicios de Autoevaluación, Thomson, 2005

BASIC ELECTRONIC RESOURCES

- RG Powell . Introduction to Electric Circuits: http://www.sciencedirect.com/science/book/9780340631980

- William H. Hayt & Jack E. Kemmerly . Engineering Circuit Analysis: https://archive.org/details/EngineeringCircuitAnalysis_280