Electrical power engineering fundamentals

Academic Year: (2020 / 2021) **Review date: 06/03/2021 12:22:46**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: MARTINEZ CRESPO, JORGE

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Students should have completed their first year. Special stress should be put into Calculus I and II, Linear Algebra and Physics Complements.

OBJECTIVES

Competences and skills
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.

Learning results
By the end of this content area, students will be able to have:
1. Knowledge and understanding of the fundamentals of electrical engineering (RA1.2). To evaluate this RA, systematic analysis exercises of DC circuits, alternating circuits and balanced three-phase testing, evaluation and laboratory practice systems (partial examinations, final examination, 3 laboratory practices) are performed.
2. Be aware of the multidisciplinary context of electrical engineering (RA1.4). To assess this RA, the links of electrical power to other disciplines of industrial engineering, such as electronic electronic engineering, thermal, and mechanical aspects, are highlighted.
3. Be able to apply your knowledge and understanding to identify, form, and solve electrical engineering problems use established methods (RA2.1). To evaluate this RA, specific evaluation tests and exercises are tested in relation to the basic electrical magnitudes (voltage, current and power).
4. Have the ability to design and perform experiments, interpret data, and draw conclusions (RA4. 2). To evaluate this RA, exercises are available in the Electrical Circuits Laboratory on the contents of direct, alternating and three-phase current and subsequently, and this knowledge is evaluated in the final exams.
5. Have technical and laboratory skills (RA4.3). To evaluate this RA, students must provide laboratory protocols evaluating practical competencies in the use of electrical instrumentation (oscilloscopes, polymeters...).
6. Have the ability to combine theory and practice to solve electrical engineering problems (RA5. 2). To evaluate this RA, a series of scripts and laboratory practices are carried out in which real circuits are solved and the systematic resolution techniques of circuits taught in the subject are applied.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction
1.1. The power system
1.2. General concepts
1.3. Kirchhoff's Laws

2. Direct current
2.1. Resistance and generators
2.2. Series and parallel associations of passive and active circuit elements
2.3. Mesh and node analysis
2.4. Theorems (Superposition, Thévenin and Norton)
3. Alternating Current
3.1. Coils and capacitors. Transients.
3.2. Waves and phasors
3.3. Impedance and admitance
3.4. Solving circuits in the frequency domain
3.5. Power in alternating current
4. Balanced three-phase circuits
4.1. General concepts
4.2. Phase and line magnitudes
4.3. Single-phase equivalent
4.4. Three-phase power and reactive power compensation
4.5. Methods of three-phase power measurement
5. Analysis of first-order transient circuits

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.

Throughout the course the teacher will propose, as a volunteer activity of the student, but with positive evaluation in the evaluation (additional points), the realization of some exercises to solve different electric circuits.

Classroom activities will be completed with three lab sessions, with a duration 100 minutes each one, on measurements and safety rules, dc circuits, ac circuits and 3-phase circuits, respectively.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	55
% of continuous assessment (assigments, laboratory, practicals…):	45

Student assessment can be done by any of three alternative methods: continuous assessment, continuous assessment +final exam or final exam only.

1) CONTINUOUS ASSESSMENT:

During the course three intermediate tests will be made consisting of the resolution of one or two problems of each of the three parts of the subject (direct current, alternating current and three-phase/transients).

The subject can be approved exclusively by continuous assessment. In this sense, all students who have taken the three intermediate tests with a minimum score of 2.5 points in each of them and have scored 5 points over 10 in the calculation of the weighted average score of the three intermediate exams will be exempted from the final exam. The final grade for continuous evaluation shall consist of 90% of the weighted average grade of the three intermediate tests (25% DC, 30% AC, 35% three-phase), and 10% of the laboratory grade (memories of the three practices). The attendance to these lab sessions is mandatory for all the students.
The students accomplishing these conditions and wanting to improve their grades can do the final exam considering the the grade will be weighted with the continuous evaluation one (see next section).

There will be an additional extra mark of up to 1 point for voluntary delivery of class exercises. This extra mark shall not be considered for the calculation of the minimum score of 5 points necessary to obtain the approved by continuous evaluation, but will be an additional mark that will increase the final

% end-of-term-examination/test:	55
% of continuous assessment (assigments, laboratory, practicals…):	45

mark obtained in the course.

2) CONTINUOUS ASSESSMENT +FINAL EXAM:

- Continuous evaluation qualification (45% of the total grade): It will be calculated as stated in the previous section (90% weighted average score of the three intermediate exams + 10% laboratory grade) to which an extra point can be added by the performance of the class exercises.
- The final exam (55% of the total grade), will consist in solving 3 - 4 numerical problems of circuit analysis, covering the whole content of the course (this part sums 50% of the total), plus a short test on the activities carried out during the lab sessions (remaining 5%).

The same criteria as above will apply in the extraordinary call (45% continuous evaluation + 55% final exam).

3) FINAL EXAM ONLY:

a) Ordinary call
- 60 % of the total record will come from a final exam consisting in solving 3 - 4 numerical problems of circuit analysis, covering the whole content of the course (this amounts to 50% of the total), plus a short test on the activities carried out during the lab sessions (remaining 10%).

b) Extraordinary call
- 100 % of the total record will come from a final exam consisting in solving 3 - 4 numerical problems of circuit analysis, covering the whole content of the course (this amounts to 90% of the total), plus a short test on the activities carried out during the lab sessions (remaining 10%).

COMMENTS ON LAB SESSIONS:
-The lab sessions are mandatory so if, without justification, none of them is made, the ordinary call will be suspended and a practical laboratory examination will be carried out in order to be eligible for the extraordinary call.

Internship validation may be requested when the following scenarios are met:
-The lab sessions were carried out in the immediately preceding course.
-Lab sessions were approved.
-The applicant has submitted to any of the calls, ordinary or extraordinary of the course immediately preceding.

BASIC BIBLIOGRAPHY

- Bruce A. Carlson Teoría de Circuitos, Thomson, 2002

- Guillermo Robles Muñoz Problemas resueltos de fundamentos de ingeniería eléctrica, Paraninfo, 2015

- J. Fraile Mora Electromagnetismo y Circuitos Eléctricos, McGraw Hill, 2005

- Julio Usaola & Mª Angeles Moreno Circuitos Eléctricos. Problemas y ejercicios resueltos, Prentice Hall, 2002

ADDITIONAL BIBLIOGRAPHY

- A. Conejo Navarro Circuitos eléctricos para la Ingeniería, McGraw-Hill, 2004

- A. Gómez Expósito Fundamentos de Teoría de Circuitos, Thomson, 2007

- A. Gómez Expósito Teoría de Circuitos. Ejercicios de autoevaluación, Thomson, 2005

- F. Barrero González Sistemas de Energía Eléctrica, Thomson, 2004