Fundamentals of electrical engineering

Academic Year: (2022 / 2023) **Review date: 12-05-2022**

Department assigned to the subject: Department of Electrical Engineering

Coordinating teacher: ARREDONDO RODRÍGUEZ, FRANCISCO

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

All first-semester courses. Among them, Calculus I and Linear Algebra are of utmost importance.

OBJECTIVES

By the end of this course, 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

1. Introduction
   1.1. General concepts
   1.2. Kirchhoff's mottos
2. DC circuits
   2.1. Dependent and independent resistors and generators
   2.2. Series and parallel associations
   2.3. Mesh and knot method
   2.4. Thévenin's theorem and superposition principle
3. Alternating current circuits
   3.1. Coils and Capacitors
   3.2. Waves and phasors
   3.3. Impedance
   3.4. Circuit resolution in the frequency domain
   3.5. AC power
4. Balanced three-phase systems
   4.1. General concepts
   4.2. Line and phase magnitudes
   4.3. Single phase equivalent
   4.4. Three-phase power and reactive compensation
5. First-order transients
   5.1 RC transients
   5.2 RL transients

LEARNING ACTIVITIES AND METHODOLOGY

This course has two weekly sessions alternating a theoretical session and a practical one:

THEORY - AGGREGATE GROUP

Theoretical concepts will be explained during lectures based on slide presentations available on Aula Global together with the solution of small problems on the blackboard. Additional multimedia material could be provided during the course. It is highly recommendable to read/hear/view the material before the class.

PRACTICE - SMALL GROUP

The teacher will solve problems using the knowledge already presented in the previous lectures and propose additional exercises to the students to practice during the class.

LABORATORY SESSIONS
Attendance is optional, but if you want to attend you need to inscribe in the group lists. There are three lab sessions:

- Basic concepts and DC systems
- AC systems
- Three-phase AC systems

Safety in the lab is a major issue. No one should turn on any devices without the supervision of the laboratory teacher. Personal and partner´s safety are the most important safety issues. Equipment safety is also important. Safety rules and indications from the teacher must always be followed. Breaking this rule may cause expulsion from the course.

There is a lab report for every session. In this report, there is a part to be completed before the lab session. Completion of this part is mandatory to get into the lab. All reports will be checked and validated. Those who fail in this part won´t be allowed in the lab.

The lab exam consists of simple exercises about different aspects learnt during the lab sessions, i.e. how to connect a voltmeter/ammeter, properly analyzing a waveform in an oscilloscope, delta/star connection of three-phase loads and so on. The evaluation of the laboratory part will be the grade of the lab exam. The lab reports will not be graded.

GENERAL INFORMATION

- Theory: Francisco Arredondo, 1.3D12, 91 624 6230, farredon@ing.uc3m.es
- Laboratory: Jesús Castro, 1.3D15, 91 624 8851, jecastro@ing.uc3m.es
- Tutorial sessions: check professor's timetable on Aula Global. The tutorial session must be previously requested via e-mail. Tutorial sessions will only be attended within office hours.

ASSESSMENT SYSTEM

THINGS TO DO DURING THE COURSE REGARDING GRADES:

- There are 3 lab sessions during the course. Lab sessions are optional, but everybody 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:

If the student has passed the lab exam AND has obtained more than 3/10 in all three partial exams, AND the average of the three partial exams is 5 or more, the student does not need to go to the ordinary call, and the grade will be the continuous evaluation grade.

2) ORDINARY CALL: CONTINUOUS EVALUATION+FINAL EXAM:

The ordinary call exam will consist of solving 3 - 9 problems of circuit analysis, covering the whole content of the course. Questions on lab sessions can be included.
Final grade calculation:
- A minimum grade of 5/10 is required to pass.
- If the student has passed the lab exam and has obtained an average of more than 2/10 in any of the three main parts of the exam (DC, AC and Three-phase), the final grade will be 40% continuous evaluation and 60% exam grade.
- If the student has NOT passed the lab exam or has obtained an average of less than 2/10 in any of the three main parts of the exam (DC, AC and Three-phase), the final grade is computed just like in the previous point, but with a maximum of 4/10. Therefore the student will not be able to pass.

3) EXTRAORDINARY CALL: 2 options

- Only an exam: The exam will consist of solving 3 - 9 problems of circuit analysis, covering the three

main parts of the course: DC, AC and Three-phase. Questions on lab sessions can be included. If the student has obtained an average of less than 2/10 in any of the three main parts of the exam (DC, AC and Three-phase), the final grade will be a maximum of 4/10. A minimum of 5/10 is required to pass.

- Exam + continuous evaluation: same as in the ordinary call.

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

BASIC BIBLIOGRAPHY

- Guillermo Robles Problemas resueltos de Fundamentos de Ingeniería Eléctrica, Paraninfo.
- James William Nilsson Electric Circuits, Pearson, 2015

ADDITIONAL BIBLIOGRAPHY

- Jesús Fraile Mora Circuitos eléctricos, Pearson.
- Jesús Fraile Mora Problemas de circuitos eléctricos, Pearson.
- Julio Usaola y A. Moreno Circuitos eléctricos. Problemas y ejercicios resueltos, Prentice Hall.

BASIC ELECTRONIC RESOURCES

- Belén García y Francisco Arredondo . Electrical Power Engineering Fundamentals: http://ocw.uc3m.es/ingenieria-electrica/electrical-power-engineering-fundamentals