Electrical power engineering fundamentals

Academic Year: (2023 / 2024) **Review date: 26-04-2023**

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)

All first-year subjects. Among them, Calculus I, Calculus II, Lineal Algebra 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.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
CG10. Ability to design and carry out experiments and to analyse and interpret the data obtained.
CG21. Knowledge and use of the principles of circuit theory and electrical machines.
ECRT10. Knowing the basic aspects of electrical machines.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA3. Engineering Design: To be able to design industrial products that comply with the required specifications, collaborating with professionals in related technologies within multidisciplinary teams.
RA4. Research and Innovation: To be able to use appropriate methods to carry out research and make innovative contributions in the field of Industrial Engineering.
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.

OBJECTIVES

Learning results.
After the student has passed this subject, he/she will be able to:
1. Have a knowledge and understanding of the fundamentals of electrical engineering. To evaluate this AR, exercises are carried out in systematic analysis of circuits of direct and alternating current and balanced triphasic systems, evaluation tests and laboratory practices (partial exams, final exam, 3 laboratory practices).
2. Be aware of the multidisciplinary context of electrical engineering. By evaluating this AR with partial and final exams and laboratory practicals, the links of electrical engineering with other disciplines of industrial engineering such as electronic, thermal, mechanical engineering and environmental aspects are revealed.

3. Have the ability to apply their knowledge and understanding to identify, formulate and solve electrical engineering problems using established methods. To evaluate this RA, evaluation tests and specific exercises are carried out in relation to the basic electrical quantities (voltage, current and power).
4. Have the ability to design and carry out experiments, interpret data and draw conclusions. In order to evaluate this RA, three practices are carried out in the Electrical Circuits Laboratory on the contents of direct, alternating and triphasic current and later, and this knowledge is evaluated in the final exams.
5. Have technical and laboratory skills. To evaluate this RA, students must deliver the laboratory protocols in which their practical skills in the use of electrical instrumentation (oscilloscopes, multimeters) are evaluated.
6. Have the ability to combine theory and practice to solve electrical engineering problems. To evaluate this AR, a series of scripts and laboratory practices are carried out in which real circuits are solved and the techniques of systematic circuit resolution taught in the subject are applied.

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 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
* Alternating power measurement
* Balanced three-phase systems
* Power measurement in three-phase systems
* Power factor compensation for energy efficiency

LEARNING ACTIVITIES AND METHODOLOGY

THEORY - AGGREGATE GROUPS

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

PRACTICE - SMALL GROUPS

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 exam consists on 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 grade of the laboratory will be the grade of the exam. The lab reports will not be graded.

REPEAT STUDENTS

- All Students, even those repeating the course, must take the laboratory test.

GENERAL INFORMATION

- Theory: Belén García, 1.3D10, 91 624 9949, bgarciad@ing.uc3m.es
- Laboratory: Belén García, bgarciad@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

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

The subject has 3 parts: continuous (CC), alternate (AC) and three-phase.
A partial of each part will be made (Parc_CC, Parc_AC, Parc_Trifásica)
-The grade of the continuous evaluation is: EvC=0.25*Parc_CC+0.35*Parc_AC+0.3*Parc_Trifásica+ 0.1*Lab
To pass the subject in continuous evaluation you must obtain an EvC grade greater than or equal to 5, with a minimum grade in each partial exam = 3 points.
-Laboratory note = evaluation of practical reports and development of their execution.
Qualification ordinary call:
If EvC is approved:
Ev=EvC
If EvC is NOT approved:
Ev=0.4*CVD+0.6*exam_january

CLARIFICATIONS ON THE PRACTICES:
Validation of internships can be requested when the following assumptions are met:
- The practices were carried out the immediately previous course.
- The practices were approved.
- The applicant has taken part in any of the calls, ordinary or extraordinary, the immediately preceding year.

BASIC BIBLIOGRAPHY

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

- James W. Nilson Electric Circuits, Pearson.

ADDITIONAL BIBLIOGRAPHY

- Guillermo Robles Problemas resueltos de Fundamentos de Ingeniería Eléctrica, Paraninfo.

- 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.