Course guide
330515 - E - Electrical Engineering

Last modified: 04/05/2023

Unit in charge: Manresa School of Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.

Degree: BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Bergas Jane, Joan Gabriel
Freijo Alvarez, Modesto

Others: Bergas Jane, Joan Gabriel
Freijo Alvarez, Modesto

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge for the calculation and design of power lines and electricity transmission.
2. Knowledge of basic concepts of electrical circuits.
3. Constituent elements of electrical circuits.

Transversal:
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
5. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
6. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

Face-to-face content presentation sessions. In which the teacher will present the concepts, guide the group and propose works.
- Face-to-face application sessions. In which the students will have to present to the professor (in groups of 6 people) the resolution of the problems and proposed works. The students who will present in each session will be chosen at random, accepting volunteers as there must be a minimum number of presentations.
- Sessions of directed activity in which the follow-up will be carried out and tutored on the evolution of the proposed works
- Self-employment. In which the student will assimilate the concepts raised, will carry out the proposed works and will prepare the classes.
- Group work. In which the students, in groups of 2 people will prepare the practices and will realize the reports.
Also, in groups of 6 people will make collections of problems that must be defended in the contact hours of application.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student must be able to:
1.- Have the fundamental knowledge on the electrical system of power: generation of power, network of transport, distribution and distribution, as well as on types of lines and conductors.
2.- Knowledge of the regulations on low and high voltage

STUDY LOAD

Type	Hours	Percentage
Hours small group	30,0	20.00
Hours large group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Content title 1: Fundamentals of electrical circuit analysis. Direct current. Basic theorems.

Description:
1.1.- Basic concepts.
1.2.- Constituent elements of electrical circuits.
1.3.- Periodic waveforms. Average value and effective value.
1.4.- Kirchhoff's Laws.
1.5.- Simple resistive circuits.
1.6.- Theorems in the resolution of electrical circuits.
1.7.- Analysis of direct current circuits.
Practice 1: DC circuits I.
Practice 2: DC circuits II.

Specific objectives:
Knowledge of the different electrical circuit analysis systems.

Related activities:
Practice 1: Direct current circuits I. Application of LTspice
Practice 2: DC circuits II. LTspice application.

Full-or-part-time: 49h
Theory classes: 12h
Laboratory classes: 4h
Self study : 33h

Title of content 2 Single-phase and three-phase alternating current circuits

Description:
2.1.- Fundamentals of electrical circuits in electrical engineering.
2.2.- Representation of sinusoidal quantities.
2.3.- Impedance and admittance.
2.4.- Power in single-phase circuits.
2.5.- Analysis of single-phase circuits in alternating current.
2.6.- Symmetrical and balanced three-phase circuits.
2.7.- Power in three-phase circuits.
2.8.- Analysis of three-phase alternating current circuits.

Specific objectives:
1. Distinguish the different configurations of the lines.
2. Calculation of inductances per meter from geometric data.
3. Calculation of the capacities in the ground per meter from geometric data.
4. Obtaining the parameters of the equivalent circuits with concentrated parameters.

Related activities:
Practice 3.- Measurement devices. Three-phase circuits with symmetrical loads. LTspice application.
Practice 4.- Unbalanced three-phase circuit. LTspice application.

Full-or-part-time: 52h
Theory classes: 16h
Laboratory classes: 6h
Self study : 30h

Content title 3 Introduction to Low Voltage electrical installations

Description:
3.1.- Low voltage electrical energy distribution. Introduction.
3.2.- The REBT and associated regulations.
3.3.- Basic elements of electrical installations.
3.4.- Protection systems and elements.
3.5.- Assisted calculation of electrical installations.

Specific objectives:
Determine the voltage drops and section calculations of the conductors.

Related activities:
Practice 5.- Electrical installations.

Full-or-part-time: 25h
Theory classes: 6h
Laboratory classes: 2h
Self study : 17h

Title of content 4 Fundamentals of rotating electrical machines

Description:
4.1.- Rotating electrical machines. Definition, constitution and classification.
4.2.- Losses. Torque and performance.
4.3.- Rotating magnetic fields.
4.4.- Three-phase asynchronous motor. Constitution and principle of operation.
4.5.- Power balance and characteristic curves of the three-phase asynchronous motor.
4.6.- Control systems. Power semiconductor devices. Converters (Choppers and inverters). Rectifiers.
4.7.- Variation and speed control of the three-phase asynchronous motor.
4.8.- Direct current motor. Constitution and principle of operation.
4.9.- Power balance and characteristic curves of the direct current motor.
4.10.- Variation and speed control of the direct current motor.
4.11.- Synchronous generator. Constitution and principle of operation.
4.12.- Other types of machines (Brushless, Stepper motor, Autocommuted reluctance motor).

Specific objectives:
Know the programming of automatons.

Related activities:
Practice 6.-Starting a three-phase motor directly from the network.

Full-or-part-time: 38h
Theory classes: 11h
Laboratory classes: 3h
Self study : 24h

ACTIVITIES

Title of activity 1: Practice P1: DIRECT CURRENT CIRCUITS

Description:
In practice, they will measure direct voltages and currents, they will learn to use the measuring devices.

Specific objectives:
Connect and use the multimeter correctly to measure voltages, currents and resistències.

Material:
Direct current generator, voltmeters, ammeters, resistive and inductive loads.

Delivery:
Throughout the session, the report will be filled out with the data obtained and the questions requested will be answered in a reasonable manner. The mark of the laboratory practices corresponds to 20% of the overall mark of the subject.

Full-or-part-time: 4h
Laboratory classes: 2h
Self study: 2h

Activity title 2: Practice P2: DIRECT CURRENT CIRCUITS II

Description:
In practice, they will measure direct voltages and currents, they will learn to use the measuring devices.

Specific objectives:
Connect and use the multimeter correctly to measure voltages, currents and resistances.

Material:
Direct current generator, voltmeters, ammeters, resistive and inductive loads.

Delivery:
Throughout the session, the report will be filled out with the data obtained and the questions requested will be answered in a reasonable manner. The mark of the laboratory practices corresponds to 20% of the overall mark of the subject.

Full-or-part-time: 6h
Laboratory classes: 2h
Self study: 4h

Title of activity 3: Practice P3: MEASURING APPARATUS. THREE PHASE CIRCUITS WITH BALANCED LOADS

Description:
In practice we will see the balanced triphasic voltages first. Next, the main magnitudes of triphasic loads will be measured.

Specific objectives:
Connect and use the multimeter correctly to measure voltages, currents and resistances.

Material:
Three-phase transformer, voltmeters, ammeters, wattmeters, three-phase inductive loads.

Delivery:
Throughout the session, the report will be filled out with the data obtained and the questions requested will be answered in a reasonable manner. The mark of the laboratory practices corresponds to 20% of the overall mark of the subject.

Full-or-part-time: 6h
Laboratory classes: 2h
Self study: 4h

Title of activity 4: Practice P4:. THREE-PHASE CIRCUITS WITH UNBALANCED LOADS

Description:
In practice we will see the balanced triphasic voltages first. Next, the main magnitudes of triphasic loads will be measured.

Specific objectives:
Understand the problems that voltage unbalance represents on three-phase loads.

Material:
Three-phase transformer, voltmeters, ammeters, wattmeters, three-phase inductive loads.

Delivery:
Throughout the session, the report will be filled out with the data obtained and the questions requested will be answered in a reasonable manner. The mark of the laboratory practices corresponds to 20% of the overall mark of the subject.

Full-or-part-time: 6h
Laboratory classes: 2h
Self study: 4h

Activity title 5: Practice P5 INDUSTRIAL ELECTRICAL INSTALLATIONS

Description:
This practice serves to familiarize the student with the software with electrical installations and their protections.

Specific objectives:
Learn to calculate and design power lines.

Material:
Magnetothermic, differential, fuse., SEE Electrical Software and others.

Delivery:
Throughout the session, the report will be filled out with the data obtained and the questions requested will be answered in a reasonable manner. The mark of the laboratory practices corresponds to 20% of the overall mark of the subject.

Full-or-part-time: 6h
Laboratory classes: 2h
Self study: 4h

Activity title 6: Practice P6 STARTING A THREE-PHASE INDUCTION MOTOR DIRECTLY FROM THE MAINS

Description:
This practice serves to familiarize the student with the software with electrical installations and their protections.

Specific objectives:
Understand the problems represented by the variation of current in the starting of a motor.

Material:
Magnetothermic, differential, fuse., SEE Electrical Software and others.

Delivery:
Throughout the session, the report will be filled out with the data obtained and the questions requested will be answered in a reasonable manner. The mark of the laboratory practices corresponds to 20% of the overall mark of the subject.

Full-or-part-time: 6h
Laboratory classes: 2h
Self study: 4h

Activity Title 7: 1st Exam

Description:
Individual test in the classroom with a part of the theoretical concepts and problems related to the learning objectives.

Specific objectives:
At the end of the activity, the student or student should be able to:
Know, understand and apply the concepts studied in the theoretical and problem sessions taught so far.

Material:
Theoretical part: only the statement. Problem part: statement, form (an A4 sheet) and calculator.

Delivery:
First delivery of the result of the theoretical written test and at the end delivery of the part of problems.
Test score: 0.2 x theory score + 0.8 x problem score.
The weight of this test is indicated in the section corresponding to the qualification system.

Full-or-part-time: 22h
Theory classes: 2h
Self study: 20h

Title of activity 8: 2nd Exam

Description:
Individual test in the classroom with a part of the theoretical concepts and problems related to the learning objectives.

Specific objectives:
At the end of the activity, the student or student should be able to:
Know, understand and apply the concepts studied in the theoretical and problem sessions taught so far.

Material:
Theoretical part: only the statement. Problem part: statement, form (an A4 sheet) and calculator.

Delivery:
First delivery of the result of the theoretical written test and at the end delivery of the part of problems.
Test score: 0.2 x theory score + 0.8 x problem score.
The weight of this test is indicated in the section corresponding to the qualification system.

Full-or-part-time: 22h
Theory classes: 2h
Self study: 20h

GRADING SYSTEM

- 1st exam: 40%
- 2nd exam: 40%
- Laboratories: 20%

EXAMINATION RULES.

The written tests are face-to-face and individual.
- In the classes of problems and / or in the practices of laboratory will value, in his case, the previous work together with the presentation of results of the activity.

BIBLIOGRAPHY

Basic:
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- Irwin, J. David. Análisis básico de circuitos en ingeniería. 6ª ed. México: Limusa Wiley, 2003. ISBN 9681862953.
- Fraile Mora, Jesús. Máquinas eléctricas. 8ª ed. Madrid: Ibergarceta, 2008. ISBN 9788416228669.

Complementary:
- Freijo Álvarez, Modesto. Problemas de electrotecnia aplicada. Manresa: REMSA, 2014.
- Moreno, Narciso; Bachiller, Alfonso; Bravo, Juan Carlos. Problemas resueltos de tecnología eléctrica. Madrid: International Thomson, 2003. ISBN 8497321944.
- Alcalde San Miguel, Pablo. Electrotecnia: instalaciones eléctricas y automáticas. 6ª ed. Madrid: Paraninfo, 2014. ISBN 9788428398770.
- Hayt, William Hart; Kemmerly, Jack E; Phillips, Jamie D; Durbin, Steven M. Análisis de circuitos en ingeniería [on line]. 9ª edición. México: McGraw-Hill, 2019 [Consultation: 27/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5808946. ISBN 9781456272135.

RESOURCES

Other resources:
1.- LTspice Free software for the calculation of electrical power circuits and SEE Electrical for the calculation of electrical installations. Siemens SCADA program.