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320011 - SE - Electric Systems

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 709 - EE - Department of Electrical Engineering

Academic year: 2019

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Alvaro Luna Alloza

Others: Emiliano Aldabas
Joan Rocabert Delgado
Sergio Giménez Arnal

Prior skills

Students will be expected to have passed Physics to take Electrical Systems.

Degree competences to which the subject contributes

Specific:

1. IND_COMMON: An understanding of and the ability to use the principles of circuit theory and electrical machines.

Transversal:

2. 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.
3. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
4. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

- Face-to-face sessions in which the lecturer will present concepts, give guidance to the group and set assignments.
- Applied face-to-face sessions in which students (in groups of 6) will have to give a presentation to show the lecturer how they solved the set assignments. The students who are to give a presentation in a session will be chosen at random, although volunteers may come forward as a certain number of presentations must be given over the course.
- Independent learning. Students will be expected to use this time to learn concepts, complete the set assignments and prepare class work.
- Group work. Students will be expected to work in pairs to prepare practical exercises and write reports. They will also work on problems in groups of six whose solutions they will have to defend in the applied face-to-face sessions.

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Learning objectives of the subject

For students to study the fundamentals, laws, techniques and methods necessary for analysing and understanding the behaviour of electrical circuits.
By the end of the first part of the subject, students will be expected to be able to analyse and justify the behaviour of the most common ways electrical circuits work.
By the end of the second part of the subject, students will be expected to understand how the most common electrical machines work and to calculate their characteristic parameters when in operation in an electrical installation.
It is also expected that students will know how to read and draw circuit diagrams, plans for installations, and understand the technical specifications in catalogues and manuals.
Finally, students will acquire the knowledge required to assemble electrical systems by reading plans and they will learn how to measure the main electrical quantities.

Study load

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	15h	10.00%
	Hours small group:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

TOPIC 1: DIRECT CURRENT CIRCUITS

Learning time: 22h 30m

Theory classes: 4h
Practical classes: 2h
Laboratory classes: 3h
Self study : 13h 30m

Description:

1.1. Introduction to the analysis of circuits
1.2. Fundamental magnitudes
1.3. Ohm's law
1.4. Kirchhoff's laws
1.5. Knot and braid theory
1.6. Equivalent circuits

Related activities:

Practical P0 - Health and safety standards in an electrical laboratory
Practical P1 - Design and measurements of direct current circuits

Specific objectives:

For students to:
- Learn the fundamental magnitudes of electrical circuits.
- Calculate currents and voltage methodically in direct current circuits.
- Carry out power balances in direct current circuits.
- Set up and conduct experiments on direct current circuits.

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TOPIC 2: ALTERNATING CURRENT CIRCUITS

Learning time: 27h 30m

Theory classes: 6h
Practical classes: 3h
Laboratory classes: 2h
Self study : 16h 30m

Description:

2.1. The sinusoidal function. Characteristic values
2.2. The concept of the phasor
2.3. Impedance and admittance
2.4. Analysis of alternating current (AC) circuits
2.5. Mutual inductance
2.6. Power in alternating currents
2.7. Correcting the power factor

Related activities:

Practical P2 - Design and measurement of alternating current circuits

Specific objectives:

For students to:
- Learn the properties of sinusoidal functions.
- Understand the concept of impedance.
- Know how to calculate the phase vector in alternating current circuits.
- Understand the concept of mutual induction.
- Calculate the power in alternating current circuits.
- Correct the power factor in alternating current circuits.
- Set up and conduct experiments on alternating current circuits.

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TOPIC 3: THREE-PHASE CIRCUITS

Learning time: 20h

Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 12h

Description:
3.1. Rationale behind three-phase systems
3.2. Connections of three-phase sources and loads
3.3. Calculation of currents in three-phase systems
3.4. Calculation and measurement of power in three-phase systems
3.5. Correction of the power factor in three-phase systems

Related activities:
Practical P3 - Design and measurement of three-phase current circuits

Specific objectives:
For students to:
- Become familiar with three-phase connections.
- Calculate voltage and current in three-phase systems.
- Calculate and measure power in three-phase systems.
- Correct the power factor in three-phase systems.
- Set up and conduct experiments on three-phase circuits.

TOPIC 5: DIRECT CURRENT MACHINES

Learning time: 20h

Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 12h

Description:
5.1. Fundamentals of the direct current motor
5.2. Electromotive force and rotation speed
5.3. Fundamental characteristics of a direct current motor
5.4. Motor torque, power and performance
5.5. Excitation systems

Related activities:
Practical P5 - Connections and measurements using a direct current machine

Specific objectives:
For students to:
- Identify the parts of a direct current motor.
- Understand the main characteristics of a direct current motor.
- Understand how direct current generators work.
- Understand how equivalent circuits in direct current motors work.
- Know the different ways a direct current motor can be connected.
- Set up and conduct experiments on direct current motors.

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TOPIC 6: TRANSFORMERS

Learning time: 20h

Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 12h

Description:
6.1. Principles of the way one-phase transformers work
6.2. Transformers at no-load and at full load
6.3. Equivalent circuits in transformers
6.4. Principles behind the way three-phase transformers work
6.5. Phase vector diagrams of three-phase transformers
6.6. Types of connections

Related activities:
Practical P6 - Connections and measurements using a transformer

Specific objectives:
For students to:
- Understand the principles behind the way three-phase transformers work.
- Understand how equivalent circuits in transformers work.
- Know the different ways a transformer can be connected.
- Identify and calculate the characteristics of a transformer.
- Set up and conduct experiments on direct current motors.

TOPIC 7: INDUCTION MACHINES

Learning time: 27h 30m

Theory classes: 6h
Practical classes: 3h
Laboratory classes: 2h
Self study : 16h 30m

Description:
7.1. Rotating magnetic fields
7.2. How one-phase motors work
7.3. How three-phase motors work
7.4. Induction generators
7.5. Equivalent circuits in induction motors
7.6. Characteristics of torque-speed
7.7. Power and performance
7.8. Connections in three-phase motors

Specific objectives:
For students to:
- Understand the principles behind the way three-induction machines work.
- Understand how equivalent circuits in induction motors work.
- Know the different ways an induction motor can be connected.
- Identify and calculate the characteristics of an induction motor.
- Set up and conduct experiments on induction motors.

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Planning of activities

PRACTICE P0: SAFETY AND REGULATIONS IN AN ELECTRICAL LAB	Hours: 2h 30m Laboratory classes: 1h Self study: 1h 30m
PRACTICE P1: DESIGN AND MEASURES IN DC CIRCUITS	Hours: 5h Laboratory classes: 2h Self study: 3h
PRACTICE P2: DESIGN AND MEASURES IN AC	Hours: 5h Laboratory classes: 2h Self study: 3h
PRACTICE P3. ¿ DESIGN AND MEASURES IN THREE PHASE CIRCUITS	Hours: 5h Laboratory classes: 2h Self study: 3h
PARTIAL EXAM	Hours: 3h Theory classes: 3h
PRACTICE P5. ¿ WIRING AND MEASURES WITH DC MACHINES	Hours: 5h Laboratory classes: 2h Self study: 3h
PRACTICE P6. ¿ WIRING AND MEASURES WITH TRANSFORMERS	Hours: 5h Laboratory classes: 2h Self study: 3h
PRACTICE P7. ¿ WIRING AND MEASURES WITH AC	Hours: 5h Laboratory classes: 2h Self study: 3h
FINAL EXAM	Hours: 3h Theory classes: 3h

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Qualification system

- First examination: 35%
- Second examination: 35%
- Assignments: 10%
- Laboratory: 20%

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

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Basic:

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Complementary:

Hayt, William H [et al.]. Análisis de circuitos en ingeniería. 6a ed. México: McGraw Hill, 2003. ISBN 9701036948.

Thomas, Roland E. Circuitos y señales : introducción a los circuitos lineales y de acoplamiento. Barcelona: Reverté, 2000. ISBN 8429134581.

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Dorf, Richard C. Circuitos eléctricos : introducción al análisis y diseño. 3a ed. Barcelona: Marcombo, 2000. ISBN 8426712711.

Martínez Pareja, Anselmo. Instalaciones eléctricas de interior, automatismos y cuadros eléctricos : conceptos prácticos. Barcelona: Marcombo, 2007. ISBN 9788426714619.

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