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320022 - TEE - Transport of Electric Power

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 ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: J. Ignacio Candela

Prior skills

- Calculation of three-phase circuits.
- Analysis of magnetically coupled networks.
- Modelling of circuits and quadrupoles.
- Transient response of a first-order system.

Degree competences to which the subject contributes

Specific:

1. ELE: understanding of electrical power systems and their applications.

CE23. ELE: Ability to calculate and design electrical power lines and transmission.

Transversal:

3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

Teaching methodology

- Face-to-face lecture sessions:
Face-to-face theory classes featuring digital presentations. To facilitate understanding, students will have access to the presentations via the Digital Campus prior to each class. Students will be assessed by means of mid-semester examinations.

- Face-to-face class work sessions:
In the applied face-to-face sessions, small groups (10¿16 students) work on problems and questions under the supervision of the lecturer. The students will be able to access directed problems and assignments via the Digital Campus. These assignments will be assessed.

- Face-to-face laboratory work sessions:
In laboratory sessions, students work in pairs. At the beginning of the academic year, students will be able to access the laboratory scripts via the Digital Campus. Students will be required to hand in a report on each practical. Students will be assessed on the basis of their laboratory work and post-practical reports.

Learning objectives of the subject

320022 - TEE - Transport of Electric Power

An understanding of the structure of an electrical system, including the generation, transport and distribution of electricity. The ability to design low-voltage electrical installations. The ability to determine the design parameters of high-voltage transmission lines. The ability to calculate and control power flux on transmission lines. An understanding of problems related to insulation coordination and protective devices. An understanding of problems related to electrical system stability.

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%

Content

TOPIC 1: General concepts of electrical power systems	Learning time: 26h 30m Theory classes: 4h 40m Practical classes: 2h 20m Laboratory classes: 3h Self study : 16h 30m

Description:
- Introduction.
- Electrical systems.
- Power flux.
- Direct, inverse and zero-sequence systems.
- Quadrupoles.
- Generators.
- Transformers.
- Calculation of per-unit value.

Related activities:
Laboratory session: Use of electrical calculation software with the most common elements and measurements.

Specific objectives:
- An understanding of how the electric power transmission and distribution system works.
- An understanding of the basic elements of the electrical system.
- A good command of specific tools for calculating electrical power systems.

TOPIC 2: Calculation of low-voltage electrical installations	Learning time: 20h Theory classes: 3h 20m Practical classes: 1h 40m Laboratory classes: 3h Self study : 12h

Description:
- Design considerations.
- Voltage drops on direct-current lines.
- Non-inductive single-phase alternating-current lines.
- Inductive single-phase alternating-current lines.
- Three-phase lines.
- Ring lines.
- Thermal considerations.

Related activities:
Laboratory session: three phase installations and transformers.
Laboratory sessions: Design of a low-voltage installation, including the calculation of voltage drops and sections.

Specific objectives:
- The ability to design low-voltage installations.
- The ability to calculate sections and voltage drops in electrical conductors.
- A basic understanding of low-voltage regulations.

TOPIC 3: High-tension lines	Learning time: 30h Theory classes: 6h Practical classes: 3h Laboratory classes: 3h Self study : 18h

Description:
- Series impedance of overhead lines.
- Capacity of overhead lines.
- Insulated high-voltage lines.
- Zero-sequence impedance.
- Equivalent circuits in power lines.

Related activities:
Laboratory sessions: Design of a medium-voltage installation and determination of impedances.

Specific objectives:
- The ability to calculate the impedance of power lines .
- Ability to use power line models.

TOPIC 4: Voltage regulation and power flux	Learning time: 32h 30m Theory classes: 6h 40m Practical classes: 3h 20m Laboratory classes: 3h Self study : 19h 30m

Description:
- Voltage regulation methods.
- Voltage drop calculation.
- Reactive power control.
- Electrical network modelling.
- Power flux.

Related activities:
Laboratory sessions: Design of a high-voltage insulation and selection of electrical conductors using load curves.

Specific objectives:
- Familiarity and ability to apply voltage-regulation methods.
- Basic knowledge of power flux.

TOPIC 5: Insulation coordination	Learning time: 31h Theory classes: 6h 40m Practical classes: 3h 20m Laboratory classes: 3h Self study : 18h

Description:
- Introduction to insulation coordination.
- Wave propagation and overvoltages.
- Overvoltage protection systems.

Related activities:
Laboratory sessions: Calculation of overvoltages, wave propagation and protection devices.

Specific objectives:
- An understanding of the purpose of insulation coordination.
- Familiarity with the various types of overvoltages.
- The ability to calculate overvoltages.
- The ability to design and select protection devices.

TOPIC 6: Stability	Learning time: 10h Theory classes: 2h 40m Practical classes: 1h 20m Self study : 6h

Description:
- Introduction
- Synchronous machine oscillation equations.
- Area stability criteria.

Specific objectives:
- An understanding of the problem of stability in electrical systems.

Qualification system

- Written examinations 60 % (1st exam: 30%; 2nd exam: 30% or 60 % for all syllabus)
- Works: 20% (Transversal 07 AAT N3)
- Practice: 20 %

Those students that fail, want to improve their mark or cannot attend to the part exam, they will have the opportunity to be examined the final exam's day. This recovery exam's mark will substitute the old one unless it is lower.

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.

Bibliography

Basic:

Barrero, Fermín. Sistemas de energía eléctrica. Madrid: Thomson, 2004. ISBN 8479322835.

Horta Bernús, Ricard [et al.]. Teoria, càlcul i disseny de línies elèctriques [on line]. Barcelona: Edicions UPC, 2001 [Consultation: 11/01/2016]. Available on: <http://hdl.handle.net/2099.3/36217>. ISBN 8483014629.

Gómez Expósito, Antonio. Análisis y operación de sistemas de energía eléctrica. Madrid: McGraw Hill Interamericana, 2002. ISBN 844813592X.

Grainger, John J. Análisis de sistemas de potencia. México: McGraw-Hill, 1996. ISBN 9701009088.

Complementary:

Carmona Fernández, Diego. Manual de instalaciones eléctricas. Badajoz: @becedario, 2005. ISBN 8493341460.

Martinez Velasco, Juan Antonio. Coordinacion de aislamiento en redes electricas de alta tension. Madrid: McGraw-Hill, 2007. ISBN 9788448166977.

Kiessling, F. [et al.]. Overhead power lines : planning, design, construction. Berlin: Springer, 2003. ISBN 3540002979.

Others resources: