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320023 - CEER - Power Plants and Renewable Energies

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

Teaching unit: 709 - EE - Department of Electrical Engineering
729 - MF - Department of Fluid Mechanics

Academic year: 2019

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan

Teaching staff

Coordinator: Jaume Saura

Others: Iñaki Candela.

Degree competences to which the subject contributes

Specific:

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

2. ELE: Ability to calculate and design electrical machines.

3. ELE: Ability to calculate and design high-voltage electrical installations.

Transversal:

4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
5. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 3. Taking social, economic and environmental factors into account in the application of solutions. Undertaking projects that tie in with human development and sustainability.

Teaching methodology

- Face-to-face lecture sessions.
- Face-to-face practical work sessions.
- Independent learning and exercises.
- Preparation and completion of group activities subject to assessment.

In the face-to-face lecture sessions, the lecturer will introduce the basic theory, concepts, methods and results for the subject and use examples to facilitate students' understanding.

There will be two types of practical class work sessions:
a) Sessions in which the lecturer will provide students with guidelines to analyse data for solving problems by applying methods, concepts and theoretical results (80%).
d) Sessions in which students give presentations of group work (20%).
Students will be expected to study in their own time so that they are familiar with concepts and are able to solve the exercises set, whether manually or with the help of a computer. In scheduled multiple-choice test sessions via the Digital Campus, students will be tested on their acquisition of knowledge, specific vocabulary related to power stations, and concepts of physics applied to power stations.

In small groups, students will carry out projects and present them publicly in applied sessions.

Learning objectives of the subject

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This subject introduces students to the various available energy sources (in particular those used in present-day use), the operating principles of each source, the ways in which power stations transform this energy into electrical energy, the power dimensions of each energy source, the main elements of power stations, and the difference between macro and micro power stations.
Students will learn to design photovoltaic systems and select wind turbines and alternators, and will gain an understanding of the excitation, regulation and control of the various types of power stations.

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:	6h	4.00%
	Self study:	84h	56.00%

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Content

TOPIC 1: WATER POWER STATIONS

Learning time: 20h

Theory classes: 10h
Self study : 10h

Description:
- Description of a hydraulic power station.
- Catchment, dams and pumped storage.
- Turbines. Hydropower exploitation.
- Alternators. Hydraulic systems. Bearings and rollers.
- Dynamo excitation.
- Generation values. Transformation, protection and control. Elevation and distribution.
- Pumping stations.
- Small water power stations.
- Water power stations in Spain.

TOPIC 2: THERMAL POWER STATIONS

Learning time: 16h

Theory classes: 8h
Self study : 8h

Description:
- Description of a thermal power station.
- Operation and work cycles.
- Thermal power stations in Spain.
- Existing coal-fired thermal power stations.
- Fossil-fuel power stations.
- Cogeneration plants.
- Biomass power stations.
- Waste-to-energy incineration plants. Municipal solid waste.

TOPIC 3: Nuclear Power Plants

Learning time: 10h

Theory classes: 5h
Self study : 5h

Description:
- Nuclear fission.
- Components of a nuclear power plant: fuel, moderator, control rods, coolant, containment building.
- Nuclear reactors.
- Operation of a nuclear power plant. Security.
- Largest nuclear power plants in Spain.

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TOPIC 4: PHOTOVOLTAIC ENERGY	Learning time: 20h Theory classes: 10h Self study : 10h

Description:
- The Sun: coordinates, position, spherical trigonometry.
- Solar radiation.
- Solar cells and panels.
- Free-standing installations.
- Grid-connected installations.
- Solar power plants.

TOPIC 5: Wind Energy	Learning time: 26h Theory classes: 13h Self study : 13h

Description:
- Wind: Average values, turbulence, speed distribution. Extreme values, wake turbulence.
- Wind turbines.
- Regulation and control. Modes of operation.
- Quality of energy produced by wind turbines.
- Wind farm.
- Largest wind farms in Spain.

TOPIC 6: GENERATORS AND EXCITATION	Learning time: 16h Theory classes: 8h Self study : 8h

Description:
- Vector diagram of currents and power.
- Excitation systems.
- Direct-current exciter.
- Rectified excitation.
- Brushless excitation.
- System control: frequency and voltage.
- Programming generation. Covering load demand.

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TOPIC 7: GENERAL CONCEPTS OF GENERATION	Learning time: 12h Theory classes: 6h Self study : 6h

Description:
- Energy and society. Energy resources. Primary energy.
- History of electrical energy generation.
- Environmental problems in electrical energy generation.
- The production market. Supply and demand. The market operator.
- Legislative framework.

Qualification system

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

The unsatisfactory results of the 1st partial exam may be redirected through a written test to be done during class hours. This test can be accessed by all enrolled students. The qualification of the test with a score of 0 and 10. The mark obtained by applying the conversion will replace the initial qualification as long as it is superior.

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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Bibliography

Basic:

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Hernández Gonzálvez, Cayetano [et al.]. Manual de minicentrales hidroeléctricas. Madrid: Instituto para la Diversificación y Ahorro de la Energía, 1996. ISBN 8480364122.

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