

Course guide

320023 - CEER - Power Plants and Renewable Energies

Last modified: 29/06/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.
729 - MF - Department of Fluid Mechanics.

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

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

LECTURER

Coordinating lecturer: Jaume Saura

Others: Iñaki Candela.
Raush Alviach, Gustavo Adolfo

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.

The students will elaborate small group works that they will present in ATENEA to be evaluated.
There are Fluid classes and materials in ATENEA that are in Spanish.

LEARNING OBJECTIVES OF THE SUBJECT

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

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours large group	30,0	20.00
Hours medium group	15,0	10.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

TOPIC 1: WATER POWER STATIONS

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.
- Alternating Current Systems, Measurement and Calculations
- Power balance, Losses and Performance

Full-or-part-time: 20h

Theory classes: 4h

Practical classes: 2h

Laboratory classes: 2h

Self study : 12h

TOPIC 2: THERMAL POWER STATIONS

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.

Full-or-part-time: 20h

Theory classes: 4h

Practical classes: 2h

Laboratory classes: 2h

Self study : 12h

TOPIC 3: Nuclear Power Plants

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.

Full-or-part-time: 10h

Theory classes: 2h

Practical classes: 1h

Laboratory classes: 1h

Self study : 6h

TOPIC 4: PHOTOVOLTAIC ENERGY

Description:

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

Full-or-part-time: 30h

Theory classes: 6h

Practical classes: 3h

Laboratory classes: 3h

Self study : 18h

TOPIC 5: Wind Energy

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.

Full-or-part-time: 40h

Theory classes: 8h

Practical classes: 4h

Laboratory classes: 4h

Self study : 24h

TOPIC 6: GENERATORS AND EXCITATION

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.

Full-or-part-time: 20h

Theory classes: 4h

Practical classes: 2h

Laboratory classes: 2h

Self study : 12h

TOPIC 7: GENERAL CONCEPTS OF GENERATION

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.

Full-or-part-time: 10h

Theory classes: 2h

Practical classes: 1h

Laboratory classes: 1h

Self study : 6h

GRADING SYSTEM

- 1st exam: 40%
- 2nd exam: 40%
- Workcals: 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.

BIBLIOGRAPHY

Basic:

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- Mataix, Claudio. Turbomáquinas térmicas: turbinas de vapor, turbinas de gas, turbocompresores. Madrid: Dossat 2000, 1998. ISBN 842370727X.
- Haywood, Richard Wilson. Análisis termodinámico de plantas eléctricas : en unidades SI. México: Limusa, 1986. ISBN 9681817729.
- Juana Sardón, José María de [et al.]. Energías renovables para el desarrollo. Madrid: ITES-Paraninfo, 2002. ISBN 8428328072.
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- Mataix, Claudio. Turbomáquinas hidráulicas: turbinas hidráulicas, bombas, ventiladores. Madrid: Editorial ICAI, 1975. ISBN 8460066622.

Complementary:

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- Barrero, Fermín. Sistemas de energía eléctrica. Madrid: Thomson, 2004. ISBN 8479322835.
- UNESA. Centrales eléctricas. Madrid: UNESA, 1998.
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