Course guide
320023 - CEER - Power Plants and Renewable Energies

Last modified: 02/04/2024

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: 2024 **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

ELECTRIC GENERATION

Description:
0.1.- Direct Current Generation 0.2.- Alternating Current Generation, Vector and Phasor. 0.3.- Generation of Alternating Currents 0.4.- Complex Impedance 0.5.- Generation of Three-Phase Alternating Currents 0.6.- Three-Phase Load in Balanced Wake 0.7.- Three-Phase Load in Unbalanced Wake 0.8.- Load III in Balanced Triangle 0.9.- Load III in Unbalanced Triangle 0.10.- â□□Y Equivalence, Transformation 0.11.- Power 0.12.- Power to the load 0.13.- Power to the balanced load 0.14.- Power to the Generation. 0.15.- Power on the line. (Method Aaron) 0.16.- Reactive power on the line. 0.17.-Losses, non-ideal systems. 0.18.- non-ideal systems. 0.19.- Improvement of the FP, minimize Q. 0.20.- Symmetrical components

Related activities:
P1.- THREE-PHASE GENERATION SYSTEMS
PR0 ELECTRICAL GENERATION SYSTEMS THERMAL PLANTS

Full-or-part-time: 19h 50m
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 11h 50m

POWER PLANTS

Description:
1.1.- Conservation of Energy 1.2.- Transformation of Energy 1.3.- Timeline energy resources 1.4.- Transformation of Energy 1.5.- Performance 1.6.- Units: Joule 1.7.- Work and Energy 1.8.- Energy kinetic, potential, Wave Energy, Thermodynamics, Nuclear Energy 1.9.- Equivalence Energy Units 1.10.- Work of a Force 1.11.- Power and Energy 1.12.- Renewable Energies 1.13.- Single source of Energy 1.14.- Vectors energetic 1.15.- Magnitude of Energy: Hydraulics. 1.16.- Magnitude of Energy: Thermal. 1.17.- Magnitude of Energy: Oil. 1.18.- Magnitude of Energy: Uranium. 1.19.- Magnitude of Energy: Comparison. 1.20.- New energy horizons: Hydrogen 1.21.- Green hydrogen: Mobility 1.22.- Hydrogen: Storage. 1.23.- Hydrogen: Fuel 1.24.- Wind Energy 1.25.- Wind power repowering 1.26.- Wind power promoting it 1.27.- Wind power waste, useful life. 1.28.- Marine wind power, future 1.30.- Wind power: Large infrastructures 1.31.- Energy and economy. office

Related activities:
P2 DIRECT CURRENT POWER PLANTS

Full-or-part-time: 19h 40m
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 11h 40m

THERMAL POWER PLANTS.

Description:
2.1.- Introduction 2.2.- Conventional thermal 2.3.- Combined cycle 2.4.- Location of thermal plants 2.5.- Coal plants 2.6.- CO2 footprint 2.7.- Decommissioning process 2.7.- Transformation process 2.8.- Information on "Ministry" 2.9.-Heating power 2.10.- Combined cycle

Related activities:
PR2 THERMAL POWER PLANTS

Full-or-part-time: 13h 45m
Theory classes: 3h
Practical classes: 2h
Self study : 8h 45m

NUCLEAR POWER PLANTS

Description:
3.1.- Nuclear Energy, Introduction 3.2.- Beginnings: The Atomists 3.3.- Nuclear Fission and Fusion 3.4.- Nuclear Fission Power Plants 3.5.- Operation of a Nuclear Power Plant 3.6.- Fission of Uranium 235 3.7.- Equivalence between mass and Energy 3.8.- Energy of a Uranium Atom. 3.9.- Isotopes and moderators 3.10.- U-235 enrichment 3.11.- Fuel rods 3.12.- Operation of a nuclear power plant 3.13.- Safety of a nuclear power plant 3.14.- Nuclear power plants in Spain 3.15.- Nuclear power plants in Mon 3.16.- PWR and BWR reactors 3.17.- Other Reactors 3.18.- Decommissioning: End of useful life 3.19.- Nuclear Accidents 3.20.- Radioactivity 3.21.- Radiation 3.22.- Environmental impact 3.23.- Atomic bomb 3.24.- Fusion Nuclear

Related activities:
PR3 NUCLEAR POWER PLANTS

Full-or-part-time: 11h 45m
Theory classes: 3h
Practical classes: 1h
Self study : 7h 45m

HYDRAULIC POWER PLANTS

Description:
4.1.- Base of hydraulic energy 4.2.- Gravity dam 4.3.- Vault dam. Buttress dam 4.4.- Pumping stations 4.5.- Turbines 4.5.- Bernoulli's equation 4.6.- Ideal power. 4.7.- Real power. 4.8.- Disturbances 4.9.- Reversible, pumping 4.10.- Energy demand 4.11.- Energy exchange for 2026 4.12.- PNIEC 2021-2030 4.13.- Beauty brought to the cinema 4.14.- Marine turbines.

Related activities:
PR4 HYDRAULIC POWER PLANTS
P5 FLUIDS TURBINE SPEEDS

Full-or-part-time: 17h 40m
Theory classes: 4h
Practical classes: 1h
Laboratory classes: 2h
Self study : 10h 40m

SYNCHRONOUS GENERATORS

Description:
5.1.- Element description 5.2.- Rotor and speed 5.3.- Equivalent Circuit 5.4.- Vector Diagram 5.5.- Test to obtain ZS 5.6.- Active, Reactive Power 5.7.- Work zone 5.8.- Useful equations 5.9.- Coupling of Generators 5.10.- Load distribution 5.11.- Q and FP distributionï□¨ Excitator 5.12.- Resistive control of the Excitator 5.13.- Excitator with 3F rectifier bridge 5.14.- DC/DC controlled exciter (Buck) 5.15.- Rectifier bridge semi-controlled Single-phase 5.16.- P. fully-controlled rectifier 1F 5.17.- Semi-controlled rectifier bridge Single-phase 5.21.- Characteristic f(P)c 5.18.- Fully-controlled rectifier bridge 3F 5.19.- Load Distribution Diagram

Related activities:
P3 COUPLING OF SYNCHRONOUS GENERATORS
PR5 SYNCHRONOUS GENERATORS

Full-or-part-time: 19h 50m
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 11h 50m

RENEWABLE ENERGY

Description:
6.1.- The sun 6.2.- The Earth 6.3.- Pollution 6.4.- Space exploration 6.5.- Movements of the Earth 6.6.- Tilt of the Earth's axis 6.7.- Movement 6.8.- Position of the Sun, declination 6.9. - Position of the Sun, Ecliptic 6.10.- Position of the Sun, Hour Angle 6.11.- Solar Irradiance, Solar Constant. 6.12.- Solar Irradiation, Types. 6.13.- Solar Irradiation, Equation. 6.14.- Clarity Index 6.15.- Solar Cell 6.16.- Solar Cell Operation 6.17.- I-V Characteristic 6.18.- Power, Performance, FF 6.19.- Equivalent Circuit 6.20.- Temperature Influence 6.21.- Photovoltaic Panel 6.22.- Protections 6.23.-I(V) Panel and Installation 6.24.- Dimensioning Installation 6.25.-Dimensioning Panels. 6.26.- Dimensions of Batteries.

Related activities:
PR6 PHOTOVOLTAIC
P4 PHOTOVOLTAIC MODULES

Full-or-part-time: 23h 45m
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 4h
Self study : 13h 45m

WIND

Description:
* Wind speed. * Weibull Distribution Law * Properties of the Weibull Function * Mean, variance and effective value of the Weibull distribution * Effective Speed * Wind Power • Actuator Disc Theory • Blade aerodynamics • Types of wind turbines • Wind as energy resource • Wind values and statistics • Wind turbine power curve * calculation examples

Related activities:
P6 WIND TUNNEL

Full-or-part-time: 23h 45m
Theory classes: 4h
Practical classes: 3h
Laboratory classes: 3h
Self study : 13h 45m

GRADING 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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