



COMILLAS

UNIVERSIDAD PONTIFICIA

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CIHS

Syllabus
2026 - 2027

GENERAL INFORMATION

Data of the subject	
Subject name	Electric Power Plants and Electrical Substations
Subject code	DIE-GITI-441
Main program	Bachelor's Degree in Engineering for Industrial Technologies
Involved programs	Grado en Ingeniería en Tecnologías Industriales [Fourth year]
Credits	4,5 ECTS
Type	Optativa (Grado)
Department	Department of Electrical Engineering
Coordinator	Matías J. Sánchez Mingarro
Office hours	Friday 12-13 h.

Teacher Information	
Teacher	
Name	Matías Juan Sánchez Mingarro
Department	Department of Electrical Engineering
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DESCRIPTION OF THE SUBJECT

Contextualization of the subject
Prerequisites
In the professional profile of the degree in Electromechanical Engineering with electrical electives, this subject extends the electrical knowledge acquired in previous subjects, focusing on the analysis and structure of the electrical system as a whole, the power plants, the high voltage substations and the electric power transmission network. Related courses: Electrical Machines and Electrical Energy Systems.

Course contents

Contents
Topic 1: Introduction to the Electrical System 1. Parts, functions and characteristics 2. Normalization and Standardization, Regulations. Legal framework. 3. Operation procedures. Demand curves. Demand coverage. Demand management. System sustainability. sustainability.
Topic 2: Power Plants



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1. Thermal power plants and thermodynamic cycles.
2. Nuclear power plants and nuclear reactions.
3. Hydraulic power plants with accumulation reservoirs, pumped storage and flowing water.
4. Solar farms: solar thermal and photovoltaic.
5. Wind farms.
6. Other types of power plants: cogeneration, biofuels, geothermal energy and the future of energy.
7. Investment and generation costs, profitability, technological mix.
8. Social and environmental impact by type of power plant.
9. Particularities of the different types of generation: analysis of operational, technological, economic and sustainability aspects.
10. Basic configurations in Ancillary Services, influence on plant availability, island operation, black-start.

Topic 3: Substations

1. Definitions. Types of substations. Design criteria. Basic configurations. Unifilar, plans and elevations.
2. Constructive forms. Air, SF6 and mixed insulation technologies. Advantages and disadvantages. Cost analysis and availability.
3. Social and environmental impact: noise, fire, electromagnetic fields. Integration with the environment, landscaping.
4. Insulation coordination, overvoltages, minimum distances.
5. Grounding network design, Spanish regulations.
6. Control and protection system. Auxiliary services.

Topic 4: Switchgear

1. General characteristics of the switchgear, regulations, manufacturing and testing.
2. Circuit breakers. Arc extinction conditions. Types and technologies. Specific characteristics, standards, manufacturing and testing. tests. Specifications and selection. Trends.
3. Disconnectors, types and technologies.
4. Current transformers. Accuracy classes. Types and technologies. Specifications and selection. Trends.
5. Voltage transformers. Precision classes. Types and technologies. Specifications and selection. Trends.
6. Power machines: transformers, reactors and capacitor banks.
7. Autovalves. Selection criteria.
8. Bus bars, types and calculation.
9. Medium Voltage Switchgear, Transformer Substations and Distribution Networks.

EVALUATION AND CRITERIA

The use of AI to produce full assignments or substantial parts thereof, without proper citation of the source or tool used, or without explicit permission in the assignment instructions, will be considered plagiarism and therefore subject to the University's General Regulations.

Evaluation activities

Evaluation criteria

Weight



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Mid-term exam + final exam	Theoretical development questions. The precision and brevity of the answer will be valued. Problem type evaluation, according to the exercises proposed in class. 20% mid-term exam 50% final exam Minimum grade of 5, taking the weighted average between the two evaluation tests, so that it can be averaged with the continuous evaluation grade. In case of retake exam is needed, its weight will be 70%.	70
Short questions in class and paper presentation	Paper on topics related to the subject. It is the innovative nature of the content and the adequacy to the adequacy to the syllabus of the subject. Continuous evaluation: multiple-choice tests of the contents of the course, one of each chapter. 15% Paper. 15% Continuous evaluation.	30

Grading

Only applicable to the paper (15%), AI level 2 is allowed: AI planning

AI may be used for pre-tak activities such as brainstorming, outlining and initial research. This level focuses on the effective use of AI for planning, synthesis, and ideation, but assessment should emphasise the ability to develop and refine these ideas independently. For all the other evaluation activities the AI use is not allowed.

BIBLIOGRAPHY AND RESOURCES

Basic References

Kundur, P. "Power System Stability and Control" EPRI Editors. Mc Graw Hill, 1994

Juan Antonio Martínez Velasco (Coordinador). "Coordinación de aislamiento en redes eléctricas de alta tensión". Mc Graw Hill, 2007

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