COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2025 - 2026

GENERAL INFORMATION

Data of the subject	
Subject name	The Challenge of Future Electricity Systems
Subject code	DIE-OPT-437
Mainprogram	Bachelor's Degree in Electromechanical Engineering
Involved programs	Grado en Ingeniería en Tecnologías Industriales [Fourth year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	3,0 ECTS
Type	Optativa (Grado)
Department	Department of Electrical Engineering
Coordinator	Pablo Frías Marín
Schedule	Morning
Office hours	Monday-Friday 10AM-6PM

Teacher Information	
Teacher	
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Name	Pablo Frías Marín
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DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

Knowledge of the basics of electrical power systems operation and planning.

Course contents

Contents

Section 1: Introduction to current power systems operation and management

- Technical Environment
- Economics, regulations, and Standards
- Case study

Section 2: Dealing with intermittency in bulk power systems

- Characterization of intermittent generation: conventional vs. RES, wind and solar
- Challenges and solutions
- Case study

Section 3: New transmission technologies

- Future transmission network design problem
- Technology portfolio: passive, active, and real-time technologies
- Case study

Section 4: Super grids (SG)

- HVDC vs. HVAC transmission systems
- Real implementation examples
- Case study

Section 5: Distributed generation (DG)

- Definition of DG
- Drivers for DG development
- Impact of DG on the network
- Case study

Section 6: New distribution technologies

- Current distribution system design: description, EU vs. USA, European business
- Network design problem
- Network automation, hardware technologies, and storage
- Microgrids
- Case study

Section 7: Demand side management (DSM)

- Electric demand
- Demand side management, demand response, and energy efficiency
- DSM costs and benefits
- Metering for billing and additional network services

- Case study

Section 8: Electrification of transportation

- EV detailed description
- Review of current EV alternatives
- Impact of EVs on distribution networks
- Impact of EVs on power systems
- Case study

Section 9: Energy storage

- Technologies
- Power system applications
- Case study

Section 10: Bigdata in Energy System

- TIC systems for Power Systems
- Big-data management and analytics with software tools
- Blockchain
- Case study

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.

Grading

Ordinary

The qualification of the course will consist of: 30% resolution of final practical cases, 40% intermediate tests, and 30% final work in the form of a technical article. The grades of the practical cases and the final work will be for the group, while the tests grades for individual follow-up. To pass the course, a minimum grade of 5 is required in each of the four previous parts.

Retake

The approved part(s) is saved, and only the failed part(s) will have to be presented. The calculation of the final grade will be the same as the ordinary call, updating the grades of the failed part(s). If the failed part is the practical cases, the failed or not presented practical cases will have to be resubmitted individually. If the failed part is the follow-up test, you will have to take an extraordinary theoretical test. If the failed part is the final work, you will have to repeat said work individually.

Important note

Failure to attend more than 15% of the classes may cause the loss of the right to take the ordinary call exam (and even the retake) of the subject (article 93.3 of the General Regulations, and articles 7.2 and 7.3 of the Academic Norms).

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date
A two-hour session every week will be assigned to each of the sections of the course.		

BIBLIOGRAPHY AND RESOURCES

Basic References
"Las redes eléctricas inteligentes", Fundación Gas Natural Fenosa (in Spanish)
"The Future of Electric Grid", MIT initiative.
"Big Data Application in Power Systems", Elsevier.
"Decentralized Frameworks for Future Power Systems", Elsevier.