Syllabus
2022 - 2023

TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Operation and Planning of Future Distribution Networks
Subject code	DIE-MII-525
Credits	6,0 ECTS
Type	Optional
Department	Department of Electrical Engineering

Teacher Information	
Teacher	
Name	Miguel Ángel Sánchez Fornié
Department	Escuela Técnica Superior de Ingeniería (ICAI)
EMail	masanchez@icai.comillas.edu
Teacher	
Name	Alezeia González García
Department	Department of Electrical Engineering
EMail	alezeia.gonzalez@iit.comillas.edu
Teacher	
Name	Álvaro Ortega Manjavacas
Department	Department of Electrical Engineering
EMail	aortega@comillas.edu
Teacher	
Name	Carlos Mateo Domingo
Department	Instituto de Investigación Tecnológica (IIT)
Office	Santa Cruz de Marcenado 26 [D-501]
EMail	Carlos.Mateo@iit.comillas.edu
Phone	2708
Teacher	
Name	Francisco Echavarren Cerezo
Department	Instituto de Investigación Tecnológica (IIT)
Office	Francisco de Ricci, 3 [D-104]
EMail	Francisco.Echavarren@iit.comillas.edu
Phone	4283
Teacher	

Name	Jose Pablo Chaves Ávila
Department	Instituto de Investigación Tecnológica (IIT)
EMail	Jose.Chaves@iit.comillas.edu
Teacher	
Name	Lukas Sigrist
Department	Instituto de Investigación Tecnológica (IIT)
EMail	Lukas.Sigrist@iit.comillas.edu
Teacher	
Name	Rafael Cossent Arín
Department	Instituto de Investigación Tecnológica (IIT)
Office	Santa Cruz de Marcenado 26
EMail	Rafael.Cossent@iit.comillas.edu
Phone	2753

SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject

Prerequisites

Students should be familiar with the fundamentals of the operation of electrical power systems. Previous knowledge of electrical network operation and the use of computer tools for their study are desirable, but not essential.

Competencies - Objectives

THEMATIC BLOCKS AND CONTENTS

Contents - Thematic Blocks

Block 1: Introduction: conventional role of distribution companies and new challenges.

1. Conventional operation and planning of distribution networks.

Role of distribution networks, tasks of distribution companies, conventional approaches to distribution network planning and operation, network components, internal organization of a distribution company.

1. New challenges and opportunities in network planning and operation.

Drivers of change (distributed energy resources, consumer empowerment, retail market developments, new business models, ICT, etc.), the need to adapt planning methods and network operation.

Block 2: New grid components and technologies.

1. New network components.

Power electronics, sensors, protections, intelligent devices, etc. and their application for network monitoring and control.

2. Grid-edge technologies

Cutting-edge technologies and distributed flexibilities: distributed storage, demand response, smart devices, distributed generation.

1. Distribution operation systems.

SCADA, DMS, OMS, NIS. State estimation

Block 3: Grid operation and smart grid solutions.

1. Voltage control

Voltage control in distribution networks, combining network solutions with local flexibility services.

2. Grid monitoring and automation.

Grid automation, new control and monitoring devices, outage management, maintenance crew management and reliability of the distribution network.

3. Islanding and microgrids.

Islanded operation and isolated microgrids.

4. Smart meters

Implementation and functionalities of smart meters: deployment, implications for retail market operation, costs and benefits, meter functionalities, data management.

5. Low voltage network monitoring and applications based on smart meter data.

Smart metering and network monitoring. Applications for grid connection, connectivity models, identification of technical/non-technical losses, phase unbalance correction, etc.

6. Operation planning under uncertainty.

Operation planning, distributed generation and demand forecasting with high granularity, network reconfiguration, etc.

Block 4: Distribution network planning under high penetrations of distributed resources.

1. Impact of distributed resources on network investments.

Incremental costs caused by distributed resources, optimal location of distributed resources, network connection alternatives.

2. Active distribution network planning.

Network planning under uncertainty (scenario-based and probabilistic planning), alternatives to conventional network reinforcements, smart grid solutions to delay or avoid network investments.

3. Network planning considering flexibility services.

Network planning and contribution of distributed resources: flexibility services, complementary network services, local markets.

TEACHING METHODOLOGY

General methodological aspects of the subject

EVALUATION AND CRITERIA

Mid-term Exam: short problems and/or multiple-choice questions.

Final exam: problem solving, short questions and/or multiple choice questions.

Individual and/or group work

Ratings

Regular assessment

Mid-term Exam: short problems and/or multiple choice questions. 25%

Final exam: problem solving, short questions and/or multiple choice questions. 60%

Individual and/or group laboratory work. 15%

Retakes

Theoretical exam 70%. In this concept, only the exam of the extraordinary call will be computed.

Individual and/or group laboratory work 30%. The grade of the individual and/or group laboratory work will be preserved if it is approved. Otherwise, a new exam will be taken.

Attendance

Class attendance is mandatory according to Article 93 of the General Regulations (Reglamento General) of Comillas Pontifical University and Article 6 of the Academic Rules (Normas Académicas) of the ICAI School of Engineering. Not complying with this requirement may have the following consequences: - Students who fail to attend more than 15% of the lectures may be denied the right to present the term task during the regular assessment period. Students who commit an irregularity in any graded activity will receive a mark of zero in the activity and disciplinary procedure will follow (cf. Article 168 of the General Regulations (Reglamento General) of Comillas Pontifical University).

BIBLIOGRAPHY AND RESOURCES

Complementary Bibliography

Operación y planificación convencional de red:

- T.A. Short. Electric Power Distribution Handbook. CRC Press, 2004
- H. Lee Willis. Power Distribution Planning Reference Book. 2nd Edition, Marcel Dekker, Inc. 2004.

Smart grids:

- Buchholz, Bernd M., Styczynski, Zbigniew. Smart Grids – Fundamentals and Technologies in Electricity Networks. Springer 2014.
- "The Future of the Electric Grid". An Interdisciplinary MIT study, 2011.
- Alberto Sendin, Miguel A. Sanchez-Fornie, Inigo Berganza, Javier Simon, Iker Urrutia. Telecommunication networks for smart grids. Artech House 2016

Observatorio:

- Prettico, G., Marinopoulos, A. and Vitiello, S., Distribution System Operator Observatory 2020, EUR 30561 EN, Publications Office of the European Union, Luxembourg, 2021.