Syllabus
2024 - 2025

TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Operation and Planning of Future Distribution Networks Laboratory
Subject code	DIE-MSG-518
Involved programs	Máster Universitario en Ingeniería Industrial + Máster in Smart Grids [First year] Máster Universitario en Ingeniería Industrial + Máster in Smart Grids [First year] Máster Universitario en Ingeniería de Telecomunicación + Máster in Smart Grids [First year] Master in Smart Grids [First year]
Level	Master
Quarter	Semestral
Credits	1,5 ECTS
Type	Obligatoria
Department	Department of Electrical Engineering
Coordinator	Carlos Mateo Domingo
Office hours	Arrange appointment at cmateo@comillas.edu

Teacher Information	
Teacher	
Name	Matteo Troncia
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SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject

Contribution to the professional profile of the degree

Distribution grids have traditionally been planned and operated with very low level of monitoring and control capabilities. This is the least cost alternative in an environment where demand was predictable and passive. Any potential grid constraint would thus be solved at the planning and connection stages through grid reinforcements.

However, the growth of distributed energy resources (DER), accompanied by fast technological development and cost reductions, are causing profound changes in the way distribution systems are planned and operated. Distribution networks need to become more flexible through the large-scale deployment of electronic devices and information and communication technologies. This new paradigm is known as smart distribution grids.

By the end of the course, students will have the ability to model many of the concept involved in this smart grid paradigm.

Prerequisites

Students willing to take this course should be familiar with the fundamentals on electric power systems. Previous experience with electricity networks and programming languages is also advisable although not required. Students must take the Operation and Planning for Future

Distribution Network simultaneously with this course as they are complementary education.

Competencies - Objectives

Learning outcomes

The objective of the course is for the student to become knowledgeable about the planning and operation of distribution networks. In particular, the specific learning outcomes are:

- To have acquired the advanced concepts presented in this course, both theoretical and practical, showing a detailed understanding about the conventional approaches to grid planning and operation.
- To understand the chief technical and economic challenges posed by the penetration of distributed energy resources to distribution system operators.
- To acquire a working knowledge of the new electronic devices and information systems that are present is smart distribution grids.
- To understand the applications of smart grid technologies for the operation of distribution systems and the integration of distributed energy resources.
- To understand the challenges and opportunities that distributed energy resources bring about for distribution network planning.

THEMATIC BLOCKS AND CONTENTS

Contents - Thematic Blocks

1. Matlab Tutorial
2. Voltage control: combining grid resources with local services
3. Islanded operation, microgrids, unintentional islanding and anti-islanding protection
4. LV data: smart metering and LV supervision. Applications to grid connection, loss collection, etc.
5. Operational planning: DG and demand forecasting with high granularity, grid reconfiguration, asset management

TEACHING METHODOLOGY

General methodological aspects of the subject

The teaching methodology combines both theoretical sessions and practical sessions that will enable the students to practice and deeply understand the problems faced in the planning and operation of distribution networks. The personal study and the individual/group assignments will complement this classroom training.

In-class Methodology: Activities

Practical sessions: use of different software tools to analyse different aspects of the planning and operation of future distribution networks. Lab sessions where students get familiar with different electrical and electronic components of distribution systems. Field visits to actual distribution grid sites.

Non-Presential Methodology: Activities

Individual/Group assignments: Learning activities that will be carried out individually or in small groups, outside of the classroom, and that will require personal research, use of software or commentary of different materials.

SUMMARY STUDENT WORKING HOURS

In-class hours:

- 15 hours devoted to problem-solving in laboratory sessions

Out-of-class hours:

- 10 hours devoted to self-studing
- 20 hours devoted to report writing.

EVALUATION AND CRITERIA

Evaluation will be based on the writing of reports corresponding to the laboratory sessions. Reports will show the correct understanding of the matter by the student.

Ratings

Grading

In order to pass the course, the average grade of all lab reports must be at least 5 out of 10 points.

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

Basic Bibliography

Notes provided by the lecturers

Complementary Bibliography

Conventional operation and planning:

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

Operation and planning of future distribution 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.