

COURSE GUIDE

2025/26

Faculty345 - Faculty of Engineering - Bilbao

Cycle.

DegreeINTER401 - Máster in Integration of Renewable Energy Sources Into The Elec

Year.

COURSE

502153 - Electrical Grid Operation. Transportation and Distribution

Credits, ECTS:3

COURSE DESCRIPTION

This course analyzes the operation and planning of transmission and distribution networks. This way, classical aspects regarding network operation, the different network states and their main features will be analyzed. New stakeholders, procedures and technologies will be studied. These aspects are currently being developed and will affect future network definition and operation. Special stress will be put on Smart Grids.
The main objective of the course is to provide students with the knowledge of the operation of distribution and transmission grids

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

COMPETENCIAS DE LA ASIGNATURA

- To explain and demonstrate knowledge and understanding of the network operation principles, identifying the most significant parameters and understanding the causes of large disturbances and incidents of Power Systems.
To analyze, summarize and employ the theoretical concepts of lectures in order to solve numerical problems and practical questions, being able to understand both qualitatively and quantitatively the obtained results.
To acquire new skills, organize information and make effective reports
To use communication skills in various forms: group discussion and exhibition

RESULTADOS DE APRENDIZAJE DE LA ASIGNATURA

- On successful completion of the module, students will be able to:
- Know and understand the network operation principles, as well as how the tools used in the process work.
 - Understand the causes and evaluate the impact of large incidents in power systems.
 - Solve numerical problems and practical questions related to the network operation, and be able to understand results both qualitatively and quantitatively.
 - Organize information and make effective reports about the network operation.
 - Communicate effectively issues regarding network operation in various forms: group discussion and expositions.

Theoretical and Practical Contents

- LESSON 1: INTRODUCTION, ENERGY TRANSITION & ENERGY POLICING
- LESSON 2: THE ELECTRICITY MARKET
- LESSON 3: ENERGY MANAGEMENT SYSTEMS
- LESSON 4: LARGE DISTURBANCES
- LESSON 5: SMART GRIDS
- LESSON 6: HVDC GRID OPERATION

METODOLOGIA (ACTIVIDADES FORMATIVAS)

Actividad Formativa	Hours	Porcentaje presencialidad
Reading and practical analysis	5	0 %
Computer work practice, laboratory, site visits, field trips, external visits	6	100 %
Classroom/Seminar/Workshop	6	100 %
Expositive classes	18	100 %
Individual work and/or group work	20	0 %
Systematised study	20	0 %

TYPES OF TEACHING

Types of teaching	M	S	GA	GL	GO	GCL	TA	TI	GCA
Hours of face-to-face teaching	18	10							2
Horas de Actividad No Presencial del Alumno/a	20	21							4

Legend:
 M: Lecture-based
 S: Seminar
 GA: Applied classroom-based groups
 GL: Applied laboratory-based groups
 GO: Applied computer-based groups
 GCL: Applied clinical-based groups
 TA: Workshop
 TI: Industrial workshop
 GCA: Applied fieldwork groups

Evaluation tools and percentages of final mark

Denominación	Ponderación mínima	Ponderación máxima
Attendance and participation	0 %	25 %
Drawing up reports and presentations	0 %	75 %
Essay, Individual work and/or group work	0 %	75 %

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

Along the course several activities will be developed:

Dynamics, deliverables and projects 100 %

Assessment:
 Procedures for assessment of the course are:
 1. Through active participation in class.
 2. By conducting dynamics, deliverables and projects

Lessons will follow a continous evaluation, for which different dynamics, deliverables and projects will be conducted.

In order to renounce to the continuous evaluation and opt for the final evaluation system, a waiver must be submitted (addressed to the course coordinator) no later than a week before the official ordinary call exam. In case the continuous evaluation is renounced, a final exam that includes 100 % of the course activities must be done.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

In the extraordinary call students can choose between continuous evaluation (by default) and a single exam that evaluates 100 % of the course activities. The chosen option must be communicated 2 weeks before the exam date.
 In order to renounce to the call, a waiver must be submitted (addressed to the master¿s academic commission) no later than a week before the official extraordinary call exam.

MANDATORY MATERIALS

All the material necessary to follow the course is facilitated by teachers of the subject during the course development, through eGela platform (<https://egela.ehu.eus/>).
 The material include: the course regulation, the course programme and the lecturers¿slides

BIBLIOGRAPHY

Basic bibliography

[1] A. Gómez Expósito, "Análisis y operación de sistemas de energía eléctrica", McGraw Hill, 2002.
 [2] A.J. Wood, B.F. Wollenberg, "power generation, operation and control" john wiley & sons, inc. EEUU, 1996.
 [3] R. Allan y R. Billinton, "probabilistic assessment of power system", proceedings of the IEEE, vol 82(2), pp 140-162, febrero 2000.
 [4] T. Gönen, "Modern power system analysis", wiley, 1988.
 [5] Stevenson, "análisis de sistemas de potencia". mc graw hill, 1996.
 [6] D. Van Hertem, O. Gomis-Bellmunt, J. Liang, "HVDC Grids: For Offshore and Supergrid of the Future" IEEE Press Series on Power Engineering, 2016

Detailed bibliography

[1] A. Medina, J. de la Casa, F. Jurado "Generación de Energía Eléctrica con Sistemas Fotovoltaicos conectados a la red". Printex SL. ISBN 978-84-92669-20-2. Año 2010
 [2] Amantegui, j. "monitoring, metering, recording and overall power system protection". cigre, ag5.3 report, 2006.
 [3] "Electrical transmission and distribution reference book", Westinghouse electric corporation, 1964

- [4] Larsson et al.. "systems protection schemes in power networks". wg. 38. 02. 19, año 2000.
- [5] Rouco, I. "análisis y operación de sistemas de energía eléctrica". capítulo 10: "estabilidad de ángulo y tensiones", McGraw Hill, 2002.
- [6] I. Zamora, J.F. Miñambres, J.M. Gallastegui, "supervisión y ensayo de relés de protección" protecciones de los sistemas eléctricos de potencia. Iberdrola Instituto Tecnológico, 1994, págs. 401-423.
- [7] Sancha, J. I. "common protection criteria in the Spanish power system. a new dynamic analysis approach". CIGRE, 34-205, 1998. Mart van der Meijden. "asset management of transmission Systems and associated CIGRE activities", CIGRE, B335, 2006.
- [8] J. Amantegui "utilities approach to protection and control refurbishment", CIGRE, 34-208, 2002.
- [9] J. Amantegui "characterisation of voltage dips in electrical network and their impact on customer installations" CIGRE, B36-104, 1998.
- [10] J. Amantegui "first project within Iberdrola group using IEC 61850 for a complete substation. final experiences and future expectations", CIGRE B5-108, 2006.
- [11] A. Janssen "changing network conditions and system requirements. part I: the impact of distributed generation (DG) on equipment rated above 1 kV", CIGRE 3-335, 2006.
- [12] Mackey "optimisation of protection performance during systems disturbances", CIGRE WG 34.09 final report, 2002.
- [13] CIGRE 683, ¿ Technical requirements and specifications of state-of-the-art HVDC switching equipment¿, Working group A3/B4.34

Journals

Web sites of interest

- [1] www.ree.es
- [2] www.omie.es
- [3] <http://www.nationalgrid.com/uk/witss.gdl.iteso.mx/solar/>
- [4] <http://www.iberdroladistribucionelctrica.com>
- [5] <http://www.ecc.de/en/about-ecc/partners-products/transmission-system-operators>
- [6] www.50hertz-transmission.net
- [7] www.smartgrids.eu
- [8] http://www.earpa.eu/earpa/39/etp_smartgrids.html
- [9] <http://www.fenix-project.org/>
- [10] <http://www.addressfp7.org/>
- [11] <http://www.greenemotion-project.eu/>
- [12] <http://www.e4v.eu/>
- [13] <http://www.energy.siemens.com/co/es/transmision-de-energia/hvdc/>
- [14] <http://www.schneider-electric.com/site/home/index.cfm/es/>
- [15] www.abb.com
- [16] www.desertec.org
- [17] www.dii-eumena.com