GUÍA DOCENTE
2018 - 2019

FICHA TÉCNICA DE LA ASIGNATURA

Datos de la asignatura	
NombreCompleto	Optativa complementaria. Current developments in power systems
Código	DIE-OPT-629
Impartido en	Máster Universitario en Ingeniería Industrial [Segundo Curso] Máster Universitario en Ingeniería Industrial y Máster Universitario en Administración de Empresas [Segundo Curso] Máster Universitario en Ingeniería Industrial y Máster Universitario en Sector Eléctrico [Primer Curso] Máster Universitario en Ingeniería Industrial y Máster Universitario en Sector Eléctrico [Segundo Curso] Máster Universitario en Ingeniería Industrial y Máster Universitario en Sistemas Ferroviarios [Segundo Curso] Máster Universitario en Ingeniería Industrial y Mast. Univ. Inves. en Modelado de Sistemas de Ingen. [Segundo Curso]
Nivel	Postgrado Oficial Master
Cuatrimestre	Semestral
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Carácter	Optativa
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GUÍA DOCENTE
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DATOS ESPECÍFICOS DE LA ASIGNATURA

Contextualización de la asignatura

Aportación al perfil profesional de la titulación

Despite the fact that electric power systems as we know them nowadays have been in operation for several decades, they are continuously evolving in order to address the new challenges they need to respond to.

In this course, students will receive an overview of the most recent developments in the different areas related to power systems, leveraging on the results of recent and ongoing research and consultancy projects developed for and in collaboration with the industry, regulators and policy-makers.

Prerrequisitos

A general background of power systems is required.

Capacity to understand and express oneself in oral and written English.

Competencias - Objetivos

Competencias

CG4. Capacidad de resolver problemas con iniciativa, toma de decisiones, creatividad, razonamiento crítico y de comunicar y transmitir conocimientos, habilidades y destrezas en el campo de la Ingeniería Industrial.

CG5. Conocimientos para la realización de mediciones, cálculos, valoraciones, tasaciones, peritaciones, estudios, informes, planes de labores y otros trabajos análogos.

CG6. Capacidad del manejo de especificaciones, reglamentos y normas de obligado cumplimiento.

CG7. Capacidad de analizar y valorar el impacto social y medioambiental de las soluciones técnicas.

Resultados de Aprendizaje

Conocimiento sobre sistemas eléctricos de potencia y sus aplicaciones.

Conocimiento aplicado sobre energías renovables.

Conocimientos básicos y aplicación de tecnologías medioambientales y sostenibilidad.

Conocimientos aplicados de organización de empresas

BLOQUES TEMÁTICOS Y CONTENIDOS

Contenidos – Bloques Temáticos

The course is structured into different modules. Each one of them addresses a specific topic by presenting, using real-life examples, the current challenges, the needs identified by the different stakeholders involved and the solutions proposed and implemented. Modules are grouped into three blocks as described below.

Block 1 – Introduction. Transmission networks and wholesale markets

1. Introduction

Overview of the whole course and introduction to the minimum level of knowledge required to follow the subsequent modules: current power systems operation and management, driving forces for the new developments in power systems, overview of existing challenges, and identification of relevant stakeholders.

2. Coordinated transmission expansion planning

Coordinated transmission and generation expansion planning with application to the European contexts: challenges, needs, models and results.

3. Planning and application of HVDC transmission supergrids

Development and operation of HVDC "supergrids" on top of existing AC transmission networks in a market environment: drivers, challenges, modelling needs and market design.

4. Electricity market design under larges shares of intermittent generation

Electricity market design to support an efficient integration of renewable energy in the European system: policy targets, role of market design, day-ahead, intraday, balancing markets.

5. Design of capacity mechanisms: theory and current trends

Drivers for the implementation of capacity mechanisms in different power systems, existing schemes and challenges faced. Recent experiences in different countries.

Block 2 – Smart grids, smart cities, smart buildings

6. Smart distribution systems

Towards a largely distributed power system with an increasing role for distribution networks. Recent experiences from demonstration projects in Europe and the US.

7. Communication systems in smart grids

New roles of ICTs in the power system: use of PLC and wireless communications applied to power systems, particularly smart distribution grids and smart homes.

8. Smart homes and smart consumers

Tools and applications to manage energy consumption in smart homes with the presence of renewables and storage systems. New technologies and business models empowering electricity consumers (energy communities, self-generation, blockchain).

Block 3 – The social component of the electricity service and particular power systems.

9. Energy poverty and social tariffs

Electricity seen as a basic need, defining vulnerable consumers, and the appropriate design of subsidies and social tariffs to attend the needs of these consumers.

10. Rural electrification and universal access

Achieving sustainable and affordable universal access to electricity supply in developing countries: challenges, modelling needs for planning, regulation and policymaking to support large-scale expansion of stand-alone, microgrids or grid extension supply, enabling sustainable business models that answer to the social, environmental and financial characteristics of these communities. Some recent experiences in India, Latin America and Africa.

11. Operation of small isolated power systems

Power system stability and control in small isolated power systems such as microgrids or islands: challenges, protection and control systems, and cost minimization.

12. Enhancing energy efficiency in railway systems

Technical solutions and operation strategies to enhance energy efficiency in railway systems subject to comfort and scheduling constraints. Experiences in subway and high speed railway lines.

METODOLOGÍA DOCENTE

Aspectos metodológicos generales de la asignatura

The teaching methodology combines theoretical background and practical case studies that will enable the students to obtain a fair understanding of the main ongoing changes and related challenges faced by power systems nowadays. The personal study and a group assignment will complement this classroom training.

Metodología Presencial: Actividades

Lectures: Presentation of the main concepts and real-life experiences by the instructor. They will include dynamic presentations, case studies, and the participation and interaction with students.

Presentation of assignments: Oral presentation of the group assignment in front of the rest of students and the course coordinator.

Metodología No presencial: Actividades

Personal study of the material to be discussed in the lectures. This is an individual activity by the students, in which they will read, analyze and question the readings provided as background material, and that will be discussed with other students and lecturers in the classroom

Group assignment: writing a report about one or several of the topics presented in the course expanding the discussion in class. This report is to be presented orally in class in front of the rest of students and the course coordinator.

RESUMEN HORAS DE TRABAJO DEL ALUMNO

In-class hours: Lectures 56h; Oral presentations 4h

Out of class hours: Self-study 40h; Data collection and reporting for group assignment 60h; Preparation of oral presentation 20h.

EVALUACIÓN Y CRITERIOS DE CALIFICACIÓN

1st intermediate test:

- **Grading criteria:** Multi-choice test and short questions to evaluate the basic understanding of the concepts in block 1.
- **Weight over final grade:** 16.67%

2nd intermediate test:

- **Grading criteria:** Multi-choice test and short questions to evaluate the basic understanding of the concepts in block 2.
- **Weight over final grade:** 16.67%

3rd intermediate test:

- **Grading criteria:** Multi-choice test and short questions to evaluate the basic understanding of the concepts in block 3.
- **Weight over final grade:** 16.67%

Group assignment and oral presentation:

- **Grading criteria:** Capability to collect and assess critically information on current challenges faced by real power systems. Understanding the relevant regulatory concepts and the perspective of the different stakeholders. Attitude and effort to take the initiative and be proactive. Written and oral skills in English language.
- **Weight over final grade:** 50%

Calificaciones

Regular assessment:

- **Three intermediate tests** will be held throughout the course, each of them covering the contents of one block. An average grade of these three tests will be calculated and it will represent **50% of the final course grade**.
- The **group assignment** will be evaluated on the basis of the report submitted and the oral presentation (including the answers to the questions from the audience and course coordinator). This grade will represent **50% of the final course grade.**
- In order to pass the course, students must have obtained **minimum grade of 5 out of 10 in each one of the two parts**. Otherwise, the grade will be the lowest of both.

Retakes:

- The grade for the group assignment will be preserved provided that this is above 50%. Otherwise, students will be required to submit a new report written individually.
- In addition, all students who failed in the regular assessment period, will have to take an exam comprising all the contents of the course.
- The final grade will be computed as the average of the grades of the group/individual assignment (50%) and the exam (50%). In order to pass the course, the mark of the final exam and the group/individual assignment must be greater or equal to 5 out of 10 points. Otherwise, the final grade will be the lower of the two marks

Course rules:

- 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 Academicas) of the ICAI School of Engineering. Not complying with this requirement may have the following consequences:

PLAN DE TRABAJO Y CRONOGRAMA

Actividades	Fecha de realización	Fecha de entrega
First intermediate test	Week 7	
Second intermediate test	Week 12	

Third intermediate test	Week 15	
Review and self-study of the concepts covered in the lectures	After each lesson	
Data collection and reporting for group assignment	During the second half of the course	Week 15
Preparation of oral presentation	Weeks 14 and 15	Week 15
Oral presentation of group assignments	Week 15	

BIBLIOGRAFÍA Y RECURSOS

Bibliografía Básica

- Case studies and references presented in each of the modules
- "Adapting Market Design to High Shares of Variable Renewable Energy". IRENA (International Renewable Energy Agency), 2017.
- "The Utility of the Future", MIT Energy Initiative, 2016.

Bibliografía Complementaria

- "Re-powering Markets: Market design and regulation during the transition to low-carbon power systems". International Energy Agency, 2016.
- "Regulation of the Power Sector", Edited by Ignacio Pérez Arriaga, Springer-Verlag, 2013.
- "Las redes eléctricas inteligentes", Fundación Gas Natural Fenosa (in Spanish)