Electricity Markets

Academic Year: (2024 / 2025) **Review date: 17-09-2024**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: MORENO LOPEZ DE SAA, MARIA ANGELES

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Electric power systems
High voltage power lines and substations
Electric rotating machines

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
COCIN4. Ability to resolve problems with initiative, decision-making, creativity, and critical reasoning skills and to communicate and transmit knowledge, skills and abilities in the Industrial Engineering field.
COCIN5. Knowledge to perform measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar jobs.
COCIN6. Ability to deal with mandatory specifications, regulations and norms.
COCIN11. Knowledge, understanding, and capacity to apply the necessary regulations while pursuing the profession of Technical Industrial Engineer.
CEP1. Capacity to design a system, component or process in the area of electrical engineering in compliance with required specifications.
CEP2. Knowledge and ability to apply computational and experimental tools for analysis and quantification of electrical engineering problems.
ECRT6. Knowledge of electrical power systems and applications.

By the end of this content area, students will be able to have:
RA1.3. Coherent knowledge of the branch of electrical engineering including some at the forefront of their branch in electric power systems.
RA2.1. The ability to apply their knowledge and understanding to analyse engineering products, processes and methods.
RA2.3. The ability to select and apply relevant analytic and modelling methods in electric power systems.
RA3.2. An understanding of design methodologies for electric power systems, and an ability to use them.
RA4.1. The ability to conduct searches of literature, and to use data bases and other sources of information.
RA5.3. An understanding of applicable techniques and methods in electric power systems, and of their limitations.
RA5.4. An awareness of the non-technical implications of engineering practice.
RA6.3. Demonstrate awareness of the health, safety and legal issues and responsibilities of engineering practice, the impact of engineering solutions in a societal and environmental context, and commit to professional ethics, responsibilities and norms of engineering practice.

OBJECTIVES

The students should know
- the fundamentals of the f-P regulation as well as the voltage control in power systems;
- the costs of thermal power plants;
- the basic principles of electricity markets and the technical and economic aspects of power system operation, including transmission constraints;
- the different ways of participating in the electricity markets;
- the retail market and the tariffs;
- the grid as a natural monopoly.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Load-frequency control
   - Load-frequency mechanism
   - Primary regulation.
   - Secondary and tertiary regulation. Load areas.

2. Voltage Regulation.
   - Voltage and power transmission capacity.
   - Voltage regulating devices.

3. Economic optimization of power systems
   - Operating costs of power plants.
   - Unit commitment.
   - Hydrothermal Coordination. Pumped-storage hydro plants.

4. Wholesale electricity markets.
   - Organized electricity markets. Auctions.
   - Congestion management methods.
   - Ancillary services. Reserve markets.

5. Participation of generation in the electricity markets
   - Thermal power stations
   - Hydropower stations
   - Other types of generation.

6. Transmission and distribution networks.
   - Definitions of transmission and distribution.
   - Regulated revenues of transmission and distribution grid.
   - Other issues: losses and connection fees.
   - Quality of supply.

7. The retail market
   - Balance of revenues and costs of the electricity system.
   - Grid tariffs and price of energy.

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures, tutorial sessions with students (3 ECTS credits)
- Computer room exercises and practical problems solved in reduced groups (3 credits ECTS)

ASSESSMENT SYSTEM

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

In ORDINARY CALL, the final grade is formed from the following elements (the approximate weight of each is indicated):
1. Final exam (40%)
2. Partial evaluation (25%)
3. Projects proposed in class (25%)
4. Grade of practical work (10%)

It is necessary to obtain a minimum grade of 4 out of 10 in the weighted average mark resulting from paragraphs 1 and 2 to approve the subject. Attendance at practice sessions is mandatory to approve the subject in ordinary call.

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

In EXTRAORDINARY CALL the final mark will be the maximum value between the mark formed from the previous conditions or 100% of the final exam. Students who have not done practicals in the computer room must take a specific exam.

BASIC BIBLIOGRAPHY

- A.G. Expósito (ed.) Análisis y operación de sistemas de energía eléctrica, McGraw-Hill, 2002

- Grainger & Stevenson Análisis de sistemas de energía eléctrica, McGraw Hill, 1995

- Kirschen & Strbac Fundamentals of Power System Economics 2nd Ed., Wiley, 2019

- Kundur Power system stability and control, Electric Power Research Institute, 1994

- Stoft Power System Economics, IEEE Press - Wiley Interscience, 2002

- Wood, Wollenberg & Sheblé Power generation, operation and control, Wiley, 2014