

Academic Year: (2023 / 2024)

Review date: 29-01-2024

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: LEDESMA LARREA, PABLO

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Basic theory of electric circuits.

OBJECTIVES

Generally, the student will be able to:

- Apply voltage and frequency control techniques to electric power systems.
- Perform basic power system studies similar to those carried out by system operators.
- Analyze the dynamic response of a power system.

More specifically, the student will acquire the following capabilities:

- Recognize the agents of a power system involved in each control system.
- Select the appropriate devices to solve voltage problems in an electric grid and to explain how they work.
- Recognize the phenomena that can result in a voltage collapse.
- Explain in detail the primary, secondary and tertiary frequency control systems.
- Explain the load shedding and other load disconnection schemes in the peninsular power system.
- Explain the behavior of the frequency control systems after different incidents in the power grid.
- Select a power system analysis software tool depending on the type of study.
- Explain the nature of electro-mechanical oscillations in a power system after a severe perturbation.
- Analyze the results of a dynamic simulation such as the performed by the transmission system operators.

DESCRIPTION OF CONTENTS: PROGRAMME

1 Power system control and regulatory frame

2 Voltage control

- Reactive power control and voltage control
- Capacitors and inductors
- Synchronous compensators
- Static VAR compensators (SVCs)
- Static synchronous compensator (STATCOM)
- Tap change transformers
- Excitation systems
- Voltage control in the Spanish regulation
- Voltage stability

3 Frequency control

- Frequency control basics
- Primary control
- Secondary control
- Other mechanisms: tertiary control, time control
- Energy reserves
- Frequency control in the Spanish regulation
- Load shedding and interruptibility service

4 Transient stability

- Definition of transient stability
- Equal area criterion
- Power system dynamic response simulation

5 What will be power systems like in the future?

LEARNING ACTIVITIES AND METHODOLOGY

- Solution of practical problems (2 ECTS)
- Computer lab sessions. (0,5 ECTS)
- Tutoring sessions. (0,2 ECTS)

Methodologies:

- Theory sessions in the classroom.
- Solution of practical problems.
- Reading and discussion of technical documents related to the course, available in Aula Global.
- Oral presentation of one topic related to power systems, chosen between a list provided by the teacher, with special emphasis on communication skills.
- Practical sessions with software PSSE.
- Tutoring sessions.

ASSESSMENT SYSTEM

Continuous Assessment:

- Midterm exams
- Laboratory sessions
- Presentation in class

Ordinary call:

- Continuous assessment 40%
- Final exam 60%

Extraordinary call:

- Continuous assessment 40%
- Final exam 60%

or

- Final exam 100%

To pass the course, it is necessary to do the lab sessions.

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

BASIC BIBLIOGRAPHY

- Kundur Power System Stability and Control, McGraw-Hill.
- Pablo Ledesma Análisis Dinámico y Control de Sistemas Eléctricos, Universidad Carlos III de Madrid, 2020

ADDITIONAL BIBLIOGRAPHY

- Kwatny, Harry G. ; Miu-Miller, Karen Power System Dynamics and Control, Springer, 2016
- N. V. Ramana Power System Operation and Control, Pearson, 2010
- Paul M. Anderson A.A Fouad Power system control and stability, Institute of Electrical and Electronics Engineers , 1977
- Pota, Hemanshu Roy The Essentials of Power System Dynamics and Control, Springer, 2018

BASIC ELECTRONIC RESOURCES

- European Network of Transmission System Operators for Electricity . ENTSOE web page: <http://www.entsoe.eu>
- Red Eléctrica de España . Página web de Red Eléctrica de España: <http://www.ree.es>