

Academic Year: ( 2022 / 2023 )

Review date: 07-04-2022

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: LEDESMA LARREA, PABLO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Solution of AC electrical circuits using phasors (e.g. Electrical Power Engineering Fundamentals in UC3M)

**OBJECTIVES**

By the end of the term, students will be able to:

1. Know and understand the scientific and mathematical principles underlying the analysis and design of power systems.
2. Understand the key aspects and concepts of power system operation.
3. Identify, formulate and solve practical problems in power systems.
4. Plan power systems to meet specific requirements.
5. Develop practical computer skills by applying software tools to the analysis of power systems.
6. Combine theory and practice to solve practical problems in power systems.

**DESCRIPTION OF CONTENTS: PROGRAMME**

Transmission and distribution grids

Transmission voltages

Meshed and radial grids

Power quality

Basic mathematical models of lines, transformers, loads and generators

Per unit quantities

Power lines

Mathematical models of a line

Power flow and voltages in a line

Conductors

Insulators

Pylons

Corona effect

The power flow problem

Power flow equations

Newton-Raphson method

Modified N-R methods

Voltage control

Shunt-connected reactors and capacitors

Automatic voltage regulation in power plants

Tap changer transformers

Ferranti effect

Voltage control in a transmission system

Voltage control in a distribution system

Substations

Disconnectors

Circuit breakers

Substation configurations

Frequency control

Primary regulation

- Secondary regulation
- Tertiary regulation
- Time control

- Protection systems
  - Contingency analysis
  - Characteristics of a protection system
  - Short circuit current
  - Fault clearing time and transient stability

- Emerging technologies in power systems
  - Energy load management
  - Electric vehicles
  - Smart meters
  - Smart grid

#### LEARNING ACTIVITIES AND METHODOLOGY

Half the time is dedicated to practical sessions in a computer laboratory, most of them with software PSSE. PSSE is used by the Spanish Transmission System Operator and by many electrical utilities to simulate the electrical network.

Also:

- Theoretical classes
- Solution of practical problems in class
- Individual tutorial sessions

#### ASSESSMENT SYSTEM

The continuous assessment will take into account:

- Assignments
- Quizzes
- Attendance and participation

Ordinary call:

If the grade of the continuous assessment is higher than 6/10, it is not necessary to take the final exam, and the continuous assessment is 100% of the grade.

Otherwise,

- Continuous assessment 40%
- Final exam 60%

Extraordinary call:

- Final exam 100%

<b>% end-of-term-examination:</b>	0
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	100

#### BASIC BIBLIOGRAPHY

- Grainger, Stevenson Power System Analysis, McGraw-Hill.
- P. Kundur Power System Stability and Control, EPRI.
- Pieter Schavemaker; Lou van der Sluis Electrical Power System Essentials, John Wiley & Sons, 2008

#### BASIC ELECTRONIC RESOURCES

- . European Network of Transmission System Operators for Electricity: <https://www.entsoe.eu>