Transmission and distribution of energy

Academic Year: (2023 / 2024) **Review date: 28-03-2023**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: LEDESMA LARREA, PABLO

Type: Electives ECTS Credits : 6.0

Year : Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

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

SKILLS AND 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.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution

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%

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	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