Transmission and distribution of energy

Academic Year: (2023 / 2024) **Review date: 07-06-2023**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: LEDESMA LARREA, PABLO

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

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.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG2. Apply computational and experimental tools for analysis and quantification of energy engineering problems
CG4. Being able to do design, analysis, calculation, manufacture, test, verification, diagnosis and maintenance of energetic systems and devices.
CG10. Being able to work in a multi-lingual and multidisciplinary environment
CE6 Módulo CRI. Ability for the analysis, design, simulation and optimization of processes and products.
CE8 Módulo CRI. Knowledge and ability for systems modelling and simulation.
CE7 Módulo TE. Ability for the calculus and design of electric power lines for energy transmission.
CE13 Módulo TE. Understanding the relation between the different variables seizing in the operation of electric power systems and the electric energy demand coverage.
CT1. Ability to communicate knowledge orally as well as in writing to a specialized and non-specialized public.
CT2. Ability to establish good interpersonal communication and to work in multidisciplinary and international teams.
CT3. Ability to organize and plan work, making appropriate decisions based on available information, gathering and interpreting relevant data to make sound judgement within the study area.
CT4. Motivation and ability to commit to lifelong autonomous learning to enable graduates to adapt to any new situation.

By the end of this content area, students will be able to have:
RA1.1 knowledge and understanding of the scientific principles underlying the branch of energetic technologies.
RA2.1 the ability to apply their knowledge and understanding to identify, formulate and solve problems within the field of energetic technologies using established methods.
RA4.2 the ability to design and conduct appropriate experiments, interpret the data and draw conclusions.
RA5.1 the ability to select and use appropriate equipment, tools and methods.
RA5.2 the ability to combine theory and practice to solve problems within the field of energetic technologies.
RA6.1 function effectively as an individual and as a member of a team.

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