Distributed generation systems

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

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: ALONSO-MARTINEZ DE LAS MORENAS, JAIME

Type: Electives ECTS Credits : 6.0

Year : Semester :

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.
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.
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.
ECRT9. Ability to design electrical power plants.
ECRT10. Applied knowledge of renewable energies.

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 generation.
RA2.1. The ability to apply their knowledge and understanding to identify, formulate and solve problems of electric power generation using established methods.
RA2.3. The ability to select and apply relevant analytic and modelling methods in electric power generation.
RA3.2. An understanding of design methodologies, and an ability to use them.
RA4.2. The ability to design and conduct appropriate experiments, interpret the data and draw conclusions.
RA5.3. An understanding of applicable techniques and methods in electric power generation, and of their limitations.
RA5.4. An awareness of the non-technical implications of engineering practice.

OBJECTIVES

After this course, the student will be familiar with the main distributed generation technologies and the main implications, both technical and economic of its integration in an existing grid.
The student should therefore be able to describe the behaviour, analyze, size and design distributed generation systems, either isolated or connected to another grid.
He should be able to choose the most appropriate technology, given a certain objective, taking into account the modifications needed by the existing grid protections, understanding the impact in power quality (reliability, system voltages, etc.) and assessing the corresponding costs.
The student should be able to simulate and design a small sistem of medium complexity that includes all the previous aspects.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Overview
   (a) A definition for Distributed Generation
   (b) Electric systems evolution
   (c) Distributed Generation versus Conventional Generation
   (d) Reasons for Distributed Generation. Future of electric systems
   (e) Main technical and economic impacts in the electric system

2. Distributed Generation technologies and theis connection to the system
   (a) Generation technologies (Piston engines, Gas turbines, Fuel cells, Renewable sources, Storage systems)
   (b) Connection types (Synchronous generators, Induction generators, DFIG, Full converter topologies)
   (c) Operating modes (Isolated systems, Parallel operation, Islanding)

3. Technical impacts of DG in electric system
   (a) Power flows
   (b) Voltages
   (c) Demand in DG systems
   (d) Generation-demand balance
   (e) Fault currents in DG systems
   (f) Protections for DG
   (g) Influence in existing system protections

4. DG in system planning
   (a) Planning process
   (b) Effects on reliability
   (c) Economics of DG
   (d) Environmental impact

5. DG and emerging grid concepts
   (a) Active grid management
   (b) Virtual generation plants
   (c) Microgrids
   (d) Smart Grids

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50