Electric power generation

Academic Year: (2021 / 2022) **Review date: 07-09-2021**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: SANTOS MARTIN, DAVID

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

All first and second year subjects. Among them, Electrical Power Engineering Fundamentals is of utmost importance.

OBJECTIVES

Students who successfully complete this course will develop the:

- Ability to perform calculations on machines using electrical circuit theories.

- Ability to explain both, the theory of electric generation in conventional power plants, and wind turbines.

- Ability to understand both, the impact of the different electric power generation plants into the grid, and the control capabilities to mitigate it.

- Capacity to work in a team and promote creative team interaction to encourage contribution from all members.

DESCRIPTION OF CONTENTS: PROGRAMME

1 Introduction to electric power generation
- Sources of energy
- Energy conversion systems
- Power generation statistics
- Generation-transmission-distribution
- Control and operation of the electric system

2 Electrical energy conversion systems

2.1 Transformers
- Introduction: why Transformers are so important?
- Types and construction of transformers
- The ideal transformer
- The equivalent circuit of a real single-phase transformer
- Transformer taps, voltage regulation and efficiency
- Three-phase transformers
- The per-unit system

2.2 Electric machinery fundamentals
- Introduction
- Basic components
- Understanding magnetic circuits and the rotating machines laws

2.3 Synchronous generator
- Introduction to synchronous machines
- Excitation systems
- Principle of operation of synchronous machines
- Equivalent electric circuit of the non-salient pole synchronous generator
- Generated power
- Capability limits

2.4 Asynchronous generator
- Introduction to asynchronous machines
- Induction generator:
  - Equivalent electric circuit
  - Power flow model
  - Tests to identify the machine parameter values
  - Torque-speed characteristic curve
  - Starting methods
  - Speed regulation
- Doubly fed induction generator:
  - Equivalent electric circuit
  - Power flow model
  - Torque-speed characteristic curve
  - Speed regulation

LEARNING ACTIVITIES AND METHODOLOGY

The learning methodology consists of:

- lectures covering the most important topics defined in the course programme.

- simple problem solving sessions focused on practical situations.

- 3 laboratory sessions covering the main systems.

ASSESSMENT SYSTEM

ORDINARY CALL (C1): CONTINUOUS EVALUATION (E1) and FINAL EXAM (E2):

- (E1) Continuous evaluation (45% of the total)

It will be calculated as the mean value of two partial assessments taking place during the lectures, typically taking place around midterm and the end of the term. They will consist in solving numerical problems and theory questions covering the whole content of the course.

- (E2) Final exam (55% of the total grade)
It will consist in solving numerical problems and theory related questions covering the whole content of the course.

C1=0.45*E1+0.55*E2

Note: to be eligeble to pass by the ordinary call (C1) it is mandatory to attend to all the laboratory sessions and have followed at least 10 problem sessions, solving all the problems at the end of the class. Furthermore E2 has to be greater or equal to 3.0/10.

EXTRAORDINARY CALL (C2)

- 100 % of the total record will come from a final exam (E3) that will consist in solving numerical problems and test questions covering the whole content of the course.

C2=E3

Note: to be eligeble to pass by the extraordinay call (C2) it is mandatory to attend to all the laboratory sessions.

% end-of-term-examination:	55
% of continuous assessment (assigments, laboratory, practicals…):	45

BASIC BIBLIOGRAPHY

- Fitzgerald & Kingsley's Electric Machinery 7TH EDITION, McGraw-Hill, 2014

- Math H. Bollen, Fainan Hassan Integration of Distributed Generation in the Power System, Wiley, 2011

- Remus Teodorescu, Marco Liserre, Pedro Rodriguez Grid Converters for Photovoltaic and Wind Power Systems, Wiley, 2011

- Stephen .J Chapman Electric Machinery Fundamentals, 5ª ed, McGraw-Hill, 2011

ADDITIONAL BIBLIOGRAPHY

- Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheble Power Generation, Operation and Control, 3rd Edition, Wiley, 2013

- Gonzalo Abad, Jesus Lopez, Miguel Rodriguez, Luis Marroyo, Grzegorz Iwanski Doubly Fed Induction Machine: Modeling and Control for Wind Energy Generation, Wiley-IEEE Press, 2011