Electric power systems

Academic Year: (2022 / 2023) **Review date: 25/01/2023 17:01:48**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: MORENO LOPEZ DE SAA, MARIA ANGELES

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Electrical Power Egineering Fundamentals
- Magnetic Circuits and Transformers
- Transmission Lines and Electrical Equipment

OBJECTIVES

The student will be able of analysing electric power systems in steady-state conditions, using using basic tools as per-unit quantities and load flow
algorithms, and also under fault conditions (symmetrical and unsymmetrical).
The student will acquire basic knowledge about the transient stability problem and the capability to analyse the transient stability in simple cases. The student will acquire basic skills in using commercial software for power system analysis.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to the electric power systems.
- Structure of a power system.
- Per-unit quantities.

2. Load flow studies.
- Problem description. Buses types.
- The Newton-Raphson method.
- Decoupled methods: Fast decoupled method and DC power flow.
- Control of power into a network.

3. Symmetrical three-phase faults.
- Transients in RL series circuits.
- Short-circuit power.
- Short-circuit currents and the reactances of synchronous machines.
- Internal voltages of loaded machines under transient conditions.
- The Bus Impedance Matrix in fault calculations.

4. Symmetrical components.
- The symmetrical components of unsymmetrical phasors.
- Symmetrical components of phase and line currents and voltages.
- Power in terms of symmetrical components.
- Sequence impedances and sequence networks.

5. Unsymmetrical faults.
- Unsymmetrical faults in power systems.
- Interconnection of Sequence networks in a single line-to-ground fault.
- Interconnection of Sequence networks in a double line-to-ground fault.
- Interconnection of Sequence networks in a line-to-line fault.
- Analysis of unsymmetrical faults using the bus impedance matrix.

6. Power system transient stability.
- The stability problem. Transient stability studies.
- The swing equation.
- The power-angle equation.
- Equal-area criterion of stability.
- Factors affecting transient stability

Computer sessions:
1. Power flow study within PSS/E.
2. Power flow control within PSS/E.
3. Symmetrical and unsymmetrical faults analysis within PSS/E.

LEARNING ACTIVITIES AND METHODOLOGY

- Magisterial classes, tutorship and personal work oriented to the acquisition of theoretical knowledge. (3 ECTS credits)
- Problems solution classes, laboratory sessions, tutorship and personal work (problems and self-assesment quizzes) oriented to the acquisition of practical skills. (3 ECTS credits)

Additionally, collective tutorship can be included in the programme.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

CONTINUOUS ASSESSMENT (100%):
- Laboratory (LAB): 3 sessions with simulation software PSSE. Attendance to the computer lab sessions is compulsory for all the new students.
- Quizzs (QZ): Online quizzs related to each topic and home work assignements.
- Partial exam 1 (P1): Convers the first half of the program. A minimum score of 2 points (from 10) in each exercise is required.
- Partial exam 2 (P2): Convers the second half of the program. A minimum score of 2 points (from 10) in each exercise is required.

Continuous grade (CG): CG = 0.10·LAB + 0.15·QZ + 0.35·P1 + 0.40·P2

If CG >=5 and MIN(P1,P2) >= 4, the subject is passed and the Final Grade (FG) is CG.

Otherwise, the final grade (FG) depends on an end-of-term-examination (EX). In this case, continuous grade is formed as:
CG = 0.1·LAB + 0.1·QZ + 0.1·P1 + 0.1·P2

- Ordinary Final Exam: FG = 0.4·CG + 0.6·EX

- Extraordinary Final Exam: FG = MAX(0.4·CG + 0.6·EX, EX)

BASIC BIBLIOGRAPHY

- Elgerd, O.I. Electric energy systems theory: an introduction, McGraw-Hill, 1982

- Gómez Expósito, Martínez Ramos, Rosendo, Romero, Riquelme Sistemas Eléctricos de Potencia. Problemas y ejercicios resueltos, Prentice Hall, 2003

- Stevenson, W.D. Elements of Power System Analysis, McGraw-Hill, 1982

ADDITIONAL BIBLIOGRAPHY

- Gómez Expósito, A. Electric energy systems: analysis and operation, CRC Press, 2009

- Kundur, P. Power System Stability and Control, McGraw-Hill, 1994

BASIC ELECTRONIC RESOURCES

- Mohamed A. El-Sharkawi . Electric energy : an introduction: https://bibliotecas.uc3m.es/permalink/f/1qk6at5/34UC3M_ALMA51257799900004213

- Ramana, N.V. . Power System Analysis: https://learning.oreilly.com/library/view/power-system-analysis/9788131755921/?ar=