Electrical machines and installations

Academic Year: (2020 / 2021) **Review date: 08-09-2020**

Department assigned to the subject: Electrical Engineering Department

Coordinating teacher: RODRIGUEZ AMENEDO, JOSE LUIS

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Fundamentos de Ingeniería Eléctrica

OBJECTIVES

By the end of this subject, students will be able to have:

1. coherent knowledge of their branch of engineering including some at the forefront of the branch in electrical machines and installations.
2. the ability to apply their knowledge and understanding of electrical machines and installations to identify, formulate and solve engineering problems using established methods.
3. workshop and laboratory skills.
4. the ability to combine theory and practice to solve engineering problems regarding electrical machines and installations.
5. an understanding of applicable techniques and methods in electrical machines and installations, and of their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Fundamentals of electromagnetics applied to ferromagnetic materials.
1.1. Electromagnetic theory review.
1.2. Hopkinson's Law and limitations. Coil inductances.
1.3. Saturation and hysteresis at ferromagnetic materials.
1.4. Eddy current losses. Power dissipation at ferromagnetic materials.
2. Transformers.
2.1. Principles about the ideal transformer.
2.2. Construction.
2.3. Equivalent circuit of a real transformer.
2.4. Voltage drop and efficiency.
2.5. Three phase transformers. Phase angle between windings.
2.6. Measurements and protection transformers.
2.7. Variacs.
3. Introduction to rotating machines.
3.1. Principles about rotating machines
3.2. Magnetic fields in the air gap.
3.3. Ferraris' Theorem.
3.4. Construction issues at AC machines.
4. The syncronous Machine.
4.1. Fundamentals. Applications.
4.2. Rotor with windings and permanent magnets.
4.3. Torque-speed characteristics. Start-up.
5. The asyncronous machine.
5.1. Fundamentals. Applications.
5.2. Equivalent circuit.
5.3. Torque-speed characteristics. Start-up.
6. Low-voltage (LV) facilities: cables and conductors.
6.1. Introduction to power distribution.
6.2. Conduction cross section calculations.
7. Internal and Linking facilities.
7.1. General sketches and definitions.
7.2. Shortcircuit currents calculations.
8. LV protection devices.
8.1. Protection against electrical shocks.

8.2. Automatic switches and fuses.
9. LV electrical facilities: Spanish regulations.
10. Medium voltage (MV) electrical grids: Equipment and substations.
10.1. Switching equipment.
10.2. Measurement and protection equipment.
10.3. Substations.
11. MV protections.
11.1. Systems.
11.2. Overcurrent protections.
12. Power quality.

Practical sessions:

1.- The three phase transformer: connections, tests for equivalent circuit.
2.- The asycronous motor: start-up and current consumption. Power factor, rotating speed and efficiency for different loads.
3.- Ground resistance measurements: connections, calculations.
4.- Transformation facilities. Switching. Switching in substations. Safety rules.

LEARNING ACTIVITIES AND METHODOLOGY

- Learning in big groups (theoretical approach), learning in small groups (solving doubts), to solve doubts (ask for them by email), individual student work. Theoretical knowledge

- Laboratory learning (4 sessions), learning in small groups (solving practical problems), to solve problems (ask for them by email), individual student work. Practical knowledge

ASSESSMENT SYSTEM

EVALUATION CRITERIA
The subject can be passed in the ordinary call or in the extraordinary call following next criteria
ORDINARY CALL
Partial exam of electrical machines, transformers and induction motors (October) 20%
Partial exam of electrical installations (December) 20%
Problem of electric machines (ordinary call-January) 25%
Problem of electrical installations (ordinary call-January) 25%
Laboratory (mandatory) 10%

There is a minimum note in the problems of the ordinary call (January) of 2/10
EXTRAORDINARY CALL
Problem of electric machines (extraordinary call-June) 45%
Problem of electrical installations (extraordinary call-June) 45%
Laboratory (mandatory) 10%

In the event that the 4 compulsory laboratory sessions have not been carried out, the student who wants to pass the subject in the extraordinary call must pass a specific laboratory test that will be eliminatory. In the case of passing the test, the qualification will have a weight of 10%.

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

BASIC BIBLIOGRAPHY

- A.J.Conejo, J.M. Arroyo, F.Milano, N.Aguacil, J.L.Polo, R.García Bertrand, J.Contreras, A.Clamagirand, L.López; ¿Instalaciones Eléctricas¿;, Mc. Graw-Hill..
- Antonio Colmenar y Juan Luis Hernández Instalaciones Eléctricas en Baja Tensión, Editorial Ra-Ma, 2007
- Fraile Mora J., "Máquinas eléctricas",, , Mc-Graw-Hill..
- Fraile Mora J., Fraile-Ardanuy J.; "Problemas de Máquinas eléctricas";, Mc-Graw-Hill..
- Guirado R., Asensi R., Jurado F., Carpio J.; ¿Tecnología Eléctrica¿;, Mc Graw Hill..
- Sanz Feito J.; "Máquinas eléctricas";, Prentice Hall..

ADDITIONAL BIBLIOGRAPHY

- Chapman, Stephen C.; "Máquinas Eléctricas";, Mc.Graw Hill..

- Fraile Mora, J; ¿Electromagnetismo y circuitos eléctricos ¿;, Servicio de publicaciones E.T.S. de Ingenieros de Caminos de Madrid..

- Sanjurjo Navarro, R.; "Máquinas eléctricas",, Mc.Graw Hill..