

Course guide

3200211 - ME1 - Electrical Machines I

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Ricard Horta Bernús

Others:

PRIOR SKILLS

Students will be expected to have passed Physics and Electrical Systems, since the knowledge acquired in those subjects is the foundation on which an understanding of electric machines will be built.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

1. ELE: Ability to calculate and design electrical machines.

TEACHING METHODOLOGY

In the lecture sessions, the lecturer presents the subject content. He/she covers the various concepts, explains what documentation will be used and assigns work.

In the face-to-face applied sessions, groups of three students present the results of their completed assignments. The lecturer decides which students will participate in each of these sessions.

Independent learning enables students to gain an understanding of each of the concepts covered by the lecturer. This type of learning also includes the completion of assignments.

Group work, done in three-person teams, includes preparation for practicals and the writing of post-practical reports.

LEARNING OBJECTIVES OF THE SUBJECT

This subject introduces students to the operation, construction, application and selection principles of electric machines (both static and rotating), as well as the design of basic parts that are common to all such machines. Students will learn to use the parameters that govern the various types of machines and interpret their characteristic curves. They will use commercial catalogues and rated quantities to determine the performance of different machines and select the most appropriate one. They will also learn to interpret and use graphic methods, recommended by international standards, for construction, use and start-up tests.

Students will learn to solve problems related to the behaviour of electric machines (generators, transformers and engines) both analytically and graphically, paying special attention to the order of magnitude and the units used in industry. They will use construction plans and diagrams to better understand the operation and configuration of the various circuits (magnetic, electric, dialectic, etc.) and their topology.



STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours medium group	15,0	10.00
Hours small group	15,0	10.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

TOPIC 0: INTRODUCTION

Description:

- 0.01. Background on electric machines. Documentation.
- 0.02. General information on electric machines.

Full-or-part-time: 3h

Theory classes: 3h

TOPIC 1: TRANSFORMERS

Description:

- 1.01. Basic principles of transformers.
- 1.02. The study of real transformers.
- 1.03. Equivalent circuits in transformers.
- 1.04. Energy balance in a transformer.
- 1.05. Polyphase transformers.
- 1.06. Transformer coupling.
- 1.07. Autotransformers.
- 1.08. Measurement transformers.
- 1.09. Special transformers.
- 1.10. Additional topics.

Related activities:

Three sessions.

- Testing of single-phase transformers to obtain their characteristic parameters and equivalent circuit.
- Testing of three-phase transformers to obtain their characteristic parameters and equivalent circuit.
- Students use current and voltage transformers to take measurements.
- Paralleling of single-phase and three-phase transformers.
- Determination of transformer winding polarity.

Full-or-part-time: 71h

Theory classes: 12h

Practical classes: 7h

Laboratory classes: 7h

Self study : 45h

TOPIC 2: SYNCHRONOUS ALTERNATING-CURRENT MACHINES

Description:

- 2.01. Basics of synchronous machines.
- 2.02. Characteristics of synchronous machines.
- 2.03. Excitation and voltage drops.
- 2.04. Alternator coupling.
- 2.05. Synchronous engines.
- 2.06. Additional topics.

Related activities:

Two sessions.

- Testing of synchronous generators to obtain their characteristic parameters and equivalent circuit.
- Parallel coupling of synchronous generators and network connections.

Full-or-part-time: 76h

Theory classes: 15h

Practical classes: 8h

Laboratory classes: 8h

Self study : 45h

GRADING SYSTEM

- Exam 1: 20%
- Exam 2: 20%
- Exam 3: 20%
- Exam 4: 20%
- Exam laboratory: 20%

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.

If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

BIBLIOGRAPHY

Basic:

- Fraile Mora, Jesús. Máquinas eléctricas. 8a ed. Madrid: Ibergarceta, 2016. ISBN 9788416228669.
- Mazón, Javier [et al.]. Guía de autoaprendizaje de máquinas eléctricas. Madrid: Pearson Educación, 2008. ISBN 9788483224908.
- Martínez Barrios, Luis. La máquina eléctrica en problemas. Barcelona: Edicions UPC, 1993. ISBN 8476533020.
- Cortés Cherta, Manuel. Curso moderno de máquinas eléctricas rotativas. Barcelona: Editores Técnicos Asociados, 1970-1989. ISBN 8471461374.

Complementary:

- Ras Oliva, Enrique. Transformadores de potencia, de medida y de protección. 7a ed. Barcelona: Marcombo, 1988. ISBN 8426706908.
- Sanz Feito, Javier. Máquinas eléctricas. Madrid: Prentice Hall, 2002. ISBN 8420533912.
- Chapman, Stephen J.; Rodríguez, Carlos; Santana, Alfredo. Máquinas eléctricas [on line]. 5a ed. México: McGraw-Hill, 2012 [Consultation : 08/03/2023]. Available on : https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4297. ISBN 9786071507242.
- Pérez Donsión, Manuel. Motores síncronos de imanes permanentes. Santiago de Compostela: Servicio de Publicaciones e Intercambio Científico, 1990. ISBN 8471916223.
- Richardson, Donald V. Máquinas eléctricas rotativas y transformadores. México: Prentice-Hall Hispanoamericana, 1990. ISBN 9868809535.