

Course guide

340733 - MAEL - Electrical Machines

Last modified: 08/07/2026

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 709 - DEE - Department of Electrical Engineering.

Degree: BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING AND RAILWAY SYSTEMS (Syllabus 2024).
(Compulsory subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Lluís Monjo Mur

Others: Lluís Monjo Mur
Joel Bravo Castro

PRIOR SKILLS

Alternating current circuit resolution, differential and integral calculus. Basic programming.

REQUIREMENTS

It is recommended to have passed Electrical Systems and Electrical Circuits.

TEACHING METHODOLOGY

- In theory classes, the theoretical foundations of the programmed subjects will be exposed and developed. They will consist of theoretical explanations complemented with activities aimed at stimulating participation, discussion and critical analysis by students.
- In problem classes, exercises corresponding to the subjects covered will be posed and solved. Students will have to solve, individually or in groups, the problems that are indicated.
- Within the laboratory hours, students will carry out the practices that are required and will submit the corresponding report of the activity together with the appropriate calculations and critical considerations.
- Group work will be carried out during the course related to some specific topics of the subject using specialized software.

LEARNING OBJECTIVES OF THE SUBJECT

- Present the main applications of the DC machine as a motor and as a generator.
- Study the constructive peculiarities of the DC machine and its operating principle.
- Analyze the behavior of the DC machine in a permanent regime using its equivalent circuit.
- Perform the necessary tests on a DC machine to determine the operating characteristic curves.

- Present the main applications of the asynchronous machine as a motor and as a generator.
- Study the constructive peculiarities of the asynchronous machine and its operating principle.
- Analyze the behavior of the asynchronous machine in a permanent regime using its equivalent circuit.
- Perform the necessary tests on an asynchronous machine to determine its equivalent circuit, as well as perform the direct test under load.

- Present the main applications of the synchronous machine as a motor and as a generator.
- Study the constructive peculiarities of the synchronous machine and its operating principle.
- Analyze the behavior of the synchronous machine in steady state using its equivalent circuit.
- Perform the necessary tests on a synchronous machine to determine its equivalent circuit.

- Present the main applications of unconventional rotating electrical machines: stepper motor, Brushless and SRM.
- Identify the different constituent parts and the operating principle of unconventional rotating electrical machines: stepper motor, Brushless and SRM.

- Use the basic principles of dimensioning to calculate electrical machines and devices, as well as use specific software for design.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	45,0	30.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

Direct current machines

Description:

Generalities. Construction forms. Operating principle.
Armature reaction. Switching.
Equivalent circuit. Determination of the parameters of the equivalent circuit.
Power balance. Operating characteristic curves.
Starting of DC motors.
The DC machine as a generator.
The universal motor.

Specific objectives:

- Identificar les diferents parts constitutives de la màquina de corrent continu.
- Interpretar el principi de funcionament de la màquina de corrent continu.
- Determinar el circuit equivalent de la màquina de corrent continu i analitzar el seu funcionament en règim permanent.
- Analitzar les corbes característiques que identifiquen el comportament del motor de corrent continu.
- Descriure quins mètodes es poden utilitzar per efectuar l'engegada del motor de corrent continu.

Full-or-part-time: 24h 30m

Theory classes: 7h 30m

Laboratory classes: 4h

Guided activities: 5h

Self study : 8h

Asynchronous machines

Description:

Generalities. Construction forms. Operating principle.
Equivalent circuit. Determination of the parameters of the equivalent circuit.
Power balance. Operating characteristic curves.
Starting the induction motor.
The induction machine operating as a generator.
Single-phase induction motors.

Full-or-part-time: 51h 30m

Theory classes: 17h 30m

Laboratory classes: 2h

Guided activities: 10h

Self study : 22h

Synchronous electrical machines

Description:

Generalities. Construction forms. Operating principle.
Equivalent circuit. Determination of the parameters of the equivalent circuit.
The synchronous generator on load. Methods for pre-determination of the excitation on load.
Synchronous generator: operation feeding an isolated load and connected to the network.
The synchronous machine as a motor. Characteristic curves.
Synchronous motor with magnets.
Synchronous machines with salient poles.

Full-or-part-time: 41h

Theory classes: 15h

Laboratory classes: 2h

Guided activities: 5h

Self study : 19h

Special machines

Description:

The stepper motor.
The brushless DC motor.
The self-commutated reluctance motor (SRM).

Full-or-part-time: 8h

Theory classes: 4h

Laboratory classes: 2h

Self study : 2h

Basis of calculation of electrical machines

Description:

Basic principles of sizing electrical machines.
Parametric calculation.
Introduction to computer-aided calculation.

Specific objectives:

- Identify the main variables and basic equations used in the sizing of electrical machines and devices.
- Use specific software for the sizing and analysis of electrical machines.

Full-or-part-time: 23h

Theory classes: 7h

Laboratory classes: 2h

Guided activities: 10h

Self study : 4h

Laboratory Exam

Description:

Laboratory validation

Full-or-part-time: 2h

Laboratory classes: 2h

GRADING SYSTEM

- EX1, EX2: Exams taken during the course (70%).
- TRE: Completion of work and exercises, in groups or individually, to be done at home and/or during the class (10%). (Not reevaluable)
- LAB: Completion of laboratory practices (No reevaluable) and validatory exam (20%)

EXAMINATION RULES.

- The written tests are face-to-face and individual.
- In the problem classes and/or laboratory practices, the previous work will be assessed, if applicable, along with the presentation of the results of the activity.

BIBLIOGRAPHY

Basic:

- Fraile Mora, Jesús. Máquinas eléctricas. 8a ed. Madrid: Ibergarceta Publicaciones, S.L, 2016. ISBN 9788416228669.
- Fraile Mora, Jesús; Fraile Ardanuy, Jesús. Problemas de máquinas eléctricas. 2a ed. Madrid: Garceta Grupo Editorial, 2015. ISBN 9788416228140.
- Sanz Feito, Javier. Máquinas eléctricas. Madrid [etc.]: Prentice Hall, 2002. ISBN 8420533912.

Complementary:

- Chapman, Stephen J. ; Santana Díaz Alfredo ; Rodríguez Pérez, Carlos. Máquinas eléctricas [on line]. 5a ed. México DF [etc.]: McGraw-Hill, 2012 [Consultation: 24/04/2026]. Available on: https://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4297. ISBN 9786071507242.