

# Course guide

## 340102 - MAE1-E4009 - Electrical Machines I

**Last modified:** 19/06/2023

**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 (Syllabus 2009). (Compulsory subject).  
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).

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

### LECTURER

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**Coordinating lecturer:** Lluís Monjo Mur

**Others:** Lluís Monjo Mur  
Torrent Burgues, Marcel

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

6. CE19. Ability to calculate design electrical machines.

**Transversal:**

1. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 3. Taking social, economic and environmental factors into account in the application of solutions. Undertaking projects that tie in with human development and sustainability.
2. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

### TEACHING METHODOLOGY

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- In the theory classes, be exposed and develop the theoretical foundations of programmed materials. They consist of theoretical explanations complemented by activities to encourage participation, discussion and critical analysis by students.
- The kinds of problems will arise and solve exercises for the subject under discussion. Students should meet individually or in groups, indicating problems.
- Within hours of laboratory practice the students will be required and submit the relevant report of the activity along with appropriate calculations and critical considerations.
- Group work will be undertaken during the course of a specific topic related to the subject.

### LEARNING OBJECTIVES OF THE SUBJECT

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- Provide the basics of transformers and rotating electrical machines.
- Know the various constituents and key technological aspects of transformers and rotating electrical machines.
- Present the different types of transformers and their applications.
- Analyze the performance of transformers (single and three phase) from the equivalent circuit.
- To study the electromechanical conversion of energy and implement their primary relationships in machinery and electrical devices.
- Present the main uses of the synchronous machine as a motor and a generator.
- Study the constructive peculiarities of the synchronous machine and its operation principle.
- Analyze the behavior of the synchronous machine in steady state using its equivalent circuit.
- Clearly identify what is meant by the parameters of the plate in electrical machines.
- Plan and implement appropriate laboratory testing electrical machines ..



## 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

### 1.- Principles of electric machinery

**Description:**

- 1.1.- Introduction to electrical machines.
- 1.2.- Main energy circuits.
- 1.3.- Nominal parameters or assigned. Losses.

**Full-or-part-time:** 31h

Theory classes: 9h  
Laboratory classes: 4h  
Self study : 18h

### 2.- Transformers

**Description:**

- 2.1.- The single-phase power transformer.
- 2.2.- Determination of circuit parameters.
- 2.3.- Three phase transformers.
- 2.4.- Other applications of the transformer.

**Full-or-part-time:** 40h

Theory classes: 12h  
Laboratory classes: 4h  
Self study : 24h

### 3.- Electromechanical Conversion of energy

**Description:**

- 3.1.- Electromechanical Systems.
- 3.2.- Energy stored in the magnetic field.
- 3.3.- Forces and torque in electromechanical systems.
- 3.4.- Dynamic equations.

**Full-or-part-time:** 26h

Theory classes: 8h  
Practical classes: 2h  
Self study : 16h

#### 4.- Technological principles of the rotating electric machinery

**Description:**

- 4.1.- Air gap magnetic field.
- 4.2.- Electromotive forces induced in the windings.
- 4.3.- Aspects of construction and operation of electrical machines.

**Full-or-part-time:** 13h

- Theory classes: 4h
- Laboratory classes: 1h
- Self study : 8h

#### 5.- Synchronous Electric Machines

**Description:**

- 5.1.- General. Constructive ways. Principle of operation.
- 5.2.- Equivalent circuit. Determination of circuit parameters.
- 5.3.- The synchronous generator load. Methods predetermination of excitation load.
- 5.4.- Synchronous Generator: feeding a load operation isolated and connected to the network.
- 5.5.- The synchronous machine as a motor. Curves.
- 5.6.- Magnet synchronous motor.
- 5.7.- Synchronous machine with salient poles.

**Full-or-part-time:** 40h

- Theory classes: 12h
- Laboratory classes: 4h
- Self study : 24h

### GRADING SYSTEM

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- First test carried out during the course (30%).
- Test conducted at the end of the course (45%).
- Realization laboratory practice (25%).

### EXAMINATION RULES.

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- The written tests are face and individual.
- In classes of problems and / or laboratory practices will be assessed, where appropriate, the prior work with the presentation of results of the activity.

### BIBLIOGRAPHY

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**Basic:**

- Chapman, Stephen J. Máquinas eléctricas [on line]. 5a ed. México DF: McGraw-Hill, 2012 [Consultation: 19/02/2024]. Available on: [https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=4297](https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4297). ISBN 9786071507242.
- Fitzgerald, A. E.; Kingsley, Charles; Umans, Stephen D. Máquinas eléctricas. 6a ed. México [etc.]: McGraw-Hill, 2004. ISBN 970104052X.

**Complementary:**

- Sanz Feito, Javier. Máquinas eléctricas. Madrid [etc.]: Prentice Hall, cop. 2002. ISBN 8420533912.
- Fraile Mora, Jesús. Máquinas eléctricas. 8a ed. Madrid: Ibergarceta, 2016. ISBN 9788416228669.



## RESOURCES

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**Other resources:**

Finite Element Method Magnetism <https://www.femm.info/>