

Introduction to Electric Machines

1. **Course number and name:** 020IMEES1 Introduction to Electric Machines
2. **Credits and contact hours:** 4 ECTS credits, 2x1:15 contact hours per week
3. **Name(s) of instructor(s) or course coordinator(s):** Gabriel Khoury
4. **Instructional Materials:** PowerPoint slides; course handouts; lab experiments.

Textbooks/References:

- R. P. BOUCHARD et G. OLIVIER, “Electrotechnique: 2^o éd.”, Presses internationales, Polytechnique, 1999.
- D. BAREILLE et J. P. DAUNIS, “Electrotechnique – Transformateurs et machines tournantes”, Dunod, 2006.
- J. CHATELAIN, “Les machines électriques, Tome 1 & 2”, Dunod, 1993 & 1984.

5. Specific course information

a. Catalog description:

This course introduces to the following topics: Magnetic materials and circuits - Three-phase regimes - Constitution, modeling and operation in steady state of the DC machine - Concept of rotating field - Constitution, equivalent diagrams and operation in steady state of the asynchronous machine and the synchronous machine.

b. Prerequisite: Electromagnetism (020EMENI3 or 020EMECI3).

c. Required for ME students.

6. Educational objectives for the course

a. Specific outcomes of instruction:

1. Carry out the study of magnetic circuits and compute the electromagnetic flux.
2. Compute the studied machines model elements from experimental tests and from the manufacturer data.
3. Use the established motor model to calculate the values of electrical and mechanical values for the three studied machines operating under load.
4. Explain the consequences on the machine performance in the case of a fault affecting the electric network feeding it, and/or the coupled mechanical component.
5. Read the information indicated on the nameplate of a machine and interpret it well in order to use it correctly.
6. Test theoretical knowledge in practice, to experimentally determine the machine model, validate its performance and draw conclusions for the different operating modes.

b. PI addressed by the course:

PI	1.1	1.2	1.3	6.1	6.2	6.3	6.4
Covered	x	x	x	x	x	x	x
Assessed				x	x	x	x

7. Brief list of topics to be covered

Chapter 1: Magnetic Materials and Circuits

- Context and use of electric machines
- Basic laws of electromagnetism
- Magnetic materials used
- Study of magnetic circuits with and without air gap

Chapter 2: The Direct Current Machines

- Elementary study of the DC motor concept
- Structure of the real DC machine
- Operation of the DC motor in steady state
- Energy balance of the machine

Chapter 3: Rotating Fields and AC Machines

- Introduction of three-phase systems
- Rotating fields generation

Chapter 4: The Asynchronous Machine

- Structure of the asynchronous machine
- Modeling of the machine in steady state
- Model elements calculation
- Energy balance of the machine

Chapter 5: The Synchronous Machine

- Structure of the synchronous machine
- Modeling of the machine in saturated and unsaturated mode in steady state
- Model elements calculation

Practical Work:

- Study of the separate excitation DC machine
- Study of the three-phase asynchronous machine