

Course Unit	Electrical Machines	Field of study	Energy Systems
Bachelor in	Electrical and Computers Engineering	School	School of Technology and Management
Academic Year	2023/2024	Year of study	2
Type	Semestral	Semester	2
Level	1-2	ECTS credits	6.0
Code	9112-742-2203-00-23		
Workload (hours)	162	Contact hours	T 30 TP - PL 30 TC - S - E - OT - O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) **Ângela Paula Barbosa da Silva Ferreira**

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. understand the theory of operation and modelling of electric transformers;
2. describe the operation and applications of autotransformers and instrument transformers;
3. understand the theory of operation and modelling of single and three-phase induction machines;

Prerequisites

Before the course unit the learner is expected to be able to:

1. understand the quasi-stationary approximation for the Maxwell's equations;
2. use vector calculus and complex numbers;
3. analyse single and three-phase AC electric circuits.

Course contents

Static and rotating electric machines: transformers and induction machines.

Course contents (extended version)

1. Introduction to machinery principles
 - Electric circuits, magnetic circuits and mechanical parts
 - Rated quantities and load regimes
 - Losses and efficiency
 - Codes and standards
 - Rotating magnetic field concept
2. Single and three-phase transformers
 - Construction features
 - Theory of operation
 - Modeling and experimental tests to determine the parameters
 - Voltage regulation and efficiency
 - Three-phase units and transformer banks; three-phase transformation using two transformers
3. Special transformers
 - Autotransformers
 - Instrument transformers
4. Three-phase induction machines
 - Construction features and theory of operation
 - Modeling and experimental tests to determine the parameters in the machine model
 - Power and torque
 - Torque-speed characteristics (motor, generator and braking modes)
 - Starting and stability of the three-phase induction motor
 - Speed control of induction motors
 - Doubly fed induction generator
5. Single-phase induction machines
 - Construction features and theory of operation
 - Major characteristics and applications

Recommended reading

1. S. J. Chapman, *Electric Machinery Fundamentals*, 5th Ed. , McGraw Hill, 2011.
2. S. L. Herman, *Electrical Transformers and Rotating Machines*, 4th Ed. , Cengage Learning, 2016.
3. J. F. Gieras, *Electrical Machines, Fundamentals of Electromechanical Energy Conversion*, CRC Press, 2020.
4. I. Boldea, *Reluctance Synchronous Machines and Drives*, Oxford University Press, 1996.

Teaching and learning methods

Theoretical classes: presentation of the course contents. Practical and laboratory classes: problem solving to support the expected learning outcomes and laboratory experiments to realize in practice some issues treated analytically.

Assessment methods

1. Distributed assessment - (Regular, Student Worker) (Final, Supplementary)
 - Laboratory Work - 40%
 - Final Written Exam - 60% (It is required a minimum classification of 25%.)
2. Global assessment - (Regular, Student Worker) (Final, Supplementary, Special)
 - Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

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29-02-2024	02-03-2024	06-03-2024	09-03-2024