Instituto Politécnico de Bragança

Course Unit	Electrical Machines			Field of study	Energy Systems
Bachelor in	Electrical and Computers Engineering			School	School of Technology and Management
Academic Year	2025/2026	Year of study	2	Level	1-2
ECTS credits	6.0				
Type	Semestral	Semester	2	Code	9112-852-2203-00-25

Workload (hours)	162	Contact hours	T -	TP 60	PL -	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 breaking 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. S. K. Sahdev, Electrical Machines, Cambridge University Press, 2018.

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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08-03-2026	08-03-2026	09-03-2026	09-03-2026