Course Unit	Power Electronic Converters and Applications	Field of study	Energy
Bachelor in	Renewable Energy Engineering	School	School of Technology and Management
Academic Year	2023/2024	Year of study	2
Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	2
Code	9910-743-2201-00-23		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			30	15	15	-	-	-	-	-

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): Américo Vicente Teixeira Leite, Felipe Lage Teixeira

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Describe the operation of basic power electronic converters based on the most commonly used Power Electronic Swiches;
2. Implement and analyse in the laboratory, with a good level of autonomy, power electronic converters, in simple applications (electric scooter).
3. Analyse the operation of power electronic converters using the PWM technique and simulation tools.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Understand single and three-phase electric circuits;
2. Analyse basic electronic circuits.

Course contents

General description of power semiconductor devices. Introduction to power electronic converters: converters from direct current to direct current (DC/DC) – step-down (Buck), step-up (Boost), and Buck-Boost and full-bridge; converters from direct current to alternating current (DC/AC) – single- and three-phase voltage source inverters; AC/DC converters – single- and three-phase diodo and thyristor rectifiers.

Course contents (extended version)

1. Fundamental characteristics of the main power semiconductor devices as electronic switches:
   - Diodes and thyristors;
   - Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs);
   - Insulated-Gate Bipolar Transistors (IGBTs).
2. Introduction to the power electronic converters:
   - Converters (DC/DC): Step-down (Buck) ; Step-up (Boost); Buck-Boost and Full-bridge converter;
   - Converters from direct current to alternating current: single and 3-phase voltage source inverter;
   - AC/DC converters – single- and three-phase diodo and thyristor rectifiers.
3. Application of power converters in electric vehicles and with renewable energy sources.

Recommended reading

1. Power Electronics. Converters, Applications and Design, N. Mohan, T. Undeland, W. Robbins, 3rd Edition, John Wiley and Sons, 2003;
2. Introduction to Power Electronics, Daniel W. Hart, Prentice-Hall, 1997;

Teaching and learning methods

Learning outcomes 1: teamwork - analysis and discussion of the results of laboratory and simulation activities; Learning outcome 2: teamwork - practical and laboratory activity; Learning outcome 3: teamwork - simulation activity.

Assessment methods

1. Peer assessment - (Regular, Student Worker) (Final)
   - Work Discussion - 50% (Evaluation of LO 1 and 3 based on written criteria.)
   - Laboratory Work - 50% (Evaluation of LO 2 based on written criteria. The overall average is assigned by the teacher.)
2. Final exam - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100% (Written component - 50%; Practical and laboratory component - 50%)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Américo Vicente Teixeira Leite, Felipe Lage Teixeira	José Luís Sousa de Magalhaes Lima	Ana Maria Alves Queiroz da Silva	José Carlos Rufino Amaro
14-02-2024	27-02-2024	03-03-2024	09-03-2024