

Course Unit	Power Electronics	Field of study	Electronics and Instrumentation
Bachelor in	Electrical and Computers Engineering	School	School of Technology and Management
Academic Year	2023/2024	Year of study	3
Type	Semestral	Semester	1
Level	1-3	ECTS credits	6.0
Code	9112-742-3102-00-23		
Workload (hours)	162	Contact hours	T 15 TP 15 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) José Luís Sousa de Magalhaes Lima, Thadeu Vinicios de Brito

### Learning outcomes and competences

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

1. Describe the basic operation and the I-V and switching characteristics of the power semiconductor devices widely used in power electronic converters applications (MOSFET and IGBT);
2. Describe control circuits, namely for the implementation of the pulse width modulation technique, in basic power electronic converters applications;
3. Describe drive circuits of power semiconductor devices, discrete and integrated, available on the market, for different applications' requirements;
4. Implement, test and analyse in the laboratory, with a good level of autonomy, control and drive circuits of power semiconductor devices in basic and small power electronic converters applications.
5. Propose and implement, in the laboratory, with a good level of autonomy, a propulsion system of an electric scooter, or other similar project.

### Prerequisites

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

1. Analyse DC electric circuits;
2. Analyse basic circuits of analogue and digital electronics;
3. Manage electronic equipment in the analysis of analogue and digital electronics.

### Course contents

Study of power semiconductor devices and their applications: diodes, thyristors (conventional, GTOs and IGBTs) and transistors (BJTs, MOSFETs and IGBTs): main technical specifications and I-V and switching characteristics. Study and implementation of drive circuits. Introduction to the basic control techniques and power electronic converters (AC/DC, DC/DC and DC/AC) based on discrete power semiconductor devices - or integrated in power modules - in different applications.

### Course contents (extended version)

1. Study of the main power semiconductor devices and their applications:
  - Power diodes and thyristors;
  - Bipolar Junction and Field-Effect Transistors; Insulated-Gate Bipolar Transistors (IGBTs).
2. Main technical specifications and I-V (static) and switching characteristics (turn on and turn off).
3. Study and implementation of protection and drive circuits.
4. Introduction to the basic control techniques based on Pulse Width Modulation (PWM).
5. Introduction to the power semiconductor devices in power converters:
  - Basic power converter topologies (DC/DC step-down converter);
  - Practical applications.

### Recommended reading

1. Power Electronics - Converters, Applications and Design, N. Mohan, T. Undeland, W. Robbins, John Wiley and Sons;
2. Power Electronics - Circuits, Devices, and Applications, Muhammad H. Rashid, Prentice Hall;
3. Power Electronics for Technology, Ashfaq Ahmed, Prentice Hall;
4. Introduction to Power Electronics, Daniel W. Hart, Prentice-Hall.

### Teaching and learning methods

Learning outcomes 1, 2 and 3: Learning based on driving questions, teamwork, discussion and sharing of learnings. Learning outcomes 4 and 5: Learning by doing experimental activities and practical project, teamwork, discussion and sharing of learnings.

### Assessment methods

1. Alternative 1 - (Regular) (Final, Supplementary, Special)
  - Final Written Exam - 40% (Theoretical questions)
  - Practical Work - 60% (Two practical works)
2. Alternative 2 - (Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 40% (Theoretical questions)
  - Practical Work - 60% (Two practical works)

### Language of instruction

Portuguese, with additional English support for foreign students.

### Electronic validation

José Luís Sousa de Magalhaes Lima, Thadeu Vinicios de Brito	José Augusto de Almeida Pinheiro Carvalho	Orlando Manuel de Castro Ferreira Soares	José Carlos Rufino Amaro
02-10-2023	02-10-2023	10-10-2023	20-10-2023