

Academic Year: ( 2022 / 2023 )

Review date: 05-09-2022

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: BARRADO BAUTISTA, ANDRES

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

## OBJECTIVES

The goal of this subject is to provide the student with multidisciplinary and solid knowledge in every aspect involved in the design, selection, and operation of power converters and power electronics systems.

Along the subject, special attention will be paid to identify the most commonly used converter topologies, modulation techniques, control strategies, power semiconductor devices, and magnetic components, applied to transform the electrical energy.

In order to achieve this goal, the student will acquire the following specific skills:

- Ability to identify the best power semiconductor for each type of application.
- To know some converter topologies for each type of energy conversion: DC-DC, DC-AC y AC-DC.
- To know the figures of merit that drive the design and optimization of the power converters.
- To know the improvements and potential advantages of the most advanced topologies that are currently used in electrical energy conversion systems.
- Ability to develop the dynamic modeling of a power converter, from a practical point of view.
- Ability to design in practice the current control loop of a power converter. This control technique is used in most of the control systems of power electronics converters applied to energy conversion.
- To know the basic protection techniques and thermal management techniques used in power converters.
- To know how Power Electronics is an enabling technology in most of the current energy applications

By the end of this course, students will be able or will have:

- A coherent knowledge of their branch of engineering including some at the forefront of the branch in power electronics.
- The ability to apply their knowledge and understanding of power electronics to identify, formulate and solve engineering problems using established methods.
- The ability to apply their knowledge and understanding to develop and realize designs to meet defined and specified requirements.
- An understanding of design methodologies, and an ability to use them.
- Workshop and laboratory skills.
- The ability to select and use appropriate equipment, tools, and methods.
- The ability to combine theory and practice to solve problems of power electronics applied to energetic systems.
- An understanding of applicable techniques and methods in power electronics, and of their limitations.

## DESCRIPTION OF CONTENTS: PROGRAMME

The subject is divided into three main blocks:

Block 1: Power Electronics applied to electrical energy production and management.

- Power supply systems in transportation. Railway, electric cars, aerospace.
- Power converters in renewable energy systems: Photovoltaics, wind power, wave energy.
- Uninterrupted Power Supplies.
- Energy recuperation systems.

Block 2: Components and topologies

- Review of basic electrical concepts and commonly used mathematical tools.
- DC-DC converters.
- Rectifiers (AC-DC).

- Inverters (DC-AC).
- Advanced topologies applied to energy conversion: multilevel converters and modular converters.
- Power losses and heat-sinks.
- Electrical protections.

Block 3: Control techniques in power converters.

- Dynamic modeling fundamental.
- Control loop design.
- Control of a grid-tied three-phase inverter.

## LEARNING ACTIVITIES AND METHODOLOGY

The teaching methodology will include::

- Magisterial Classes (3 ECTS), where the students will be presented with the basic knowledge they must acquire. Students will be supplied with lecture notes and key reference texts that will enable them to complete and acquire a more in-depth knowledge of the subject.
- Problems Classes and Laboratory Classes (3 ECTS) are aimed at the solving of exercises and examples within the context of real case studies. These classes will be complemented with the resolution of practical exercises on behalf of the student that in some cases may require the use of computer-based simulation programs. The Laboratory classes will be developed taking into account a double methodology. In the first session, the student will design mount and measure a real DC-DC converter. In the next sessions, students will use the most convenient CAD tools applied to design and simulate power converters such as grid-tied inverters.
- Group tutorial: At least a group tutorial will be carried out during the recovery week as revision and final exam preparation.

## ASSESSMENT SYSTEM

A continuous evaluation system will be carried out where the following will be evaluated:

1. Compulsory Laboratory Sessions (20%): The knowledge acquired by the student will be evaluated by means of the experimental implementation and simulation of several of the power converters analyzed previously in the Magisterial and Problems classes. The development of the laboratory sessions will be carried out in groups.
2. Solving problems and/or test questions proposed for each thematic block (20%). The resolution will be carried out individually.
3. Final exam (60%). In addition, at the end of the course, a final exam will be carried out where the global knowledge acquired by the students will be evaluated. A minimum mark will be required in the written assessment.

Final exam Percentage: 60

Continuous evaluation Percentage: 40

<b>% end-of-term-examination:</b>	60
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	40

## BASIC BIBLIOGRAPHY

- BARRADO, A. LÁZARO Problemas de Electrónica de Potencia, Pearson Prentice Hall, 2007
- D.W. HART Power Electronics, McGraw-Hill Education, 2010

## ADDITIONAL BIBLIOGRAPHY

- A. YAZDANI, R. IRAVANI Voltage-Sourced Converters in Power Systems, IEEE PRESS & Wiley , 2010
- D.G. HOLMES, T.A. LIPO Pulse Width Modulation for Power Converters, IEEE PRESS & Wiley Interscience, 2003
- M.H. RASHID Electrónica de Potencia: Circuitos, Dispositivos y Aplicaciones, Pearson Prentice-Hall, 2004
- N. MOHAN, T.M. UNDELAND, W.P. ROBBINS Power electronics, converters, applications and design, John Wiley & Sons, 2003
- R. TEODORESCU, M. LISERRE, P. RODRIGUEZ Grid Converters for Photovoltaic and Wind Power Systems, IEEE Press - Wiley, 2011
- R.W. ERICKSON, D. MAKSIMOVIC Fundamentals of Power Electronics, Kluwer Academic Publishers, 2001

