COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2023 - 2024

GENERAL INFORMATION

Data of the subject	
Subject name	Power Electronics
Subject code	DEA-GITI-441
Mainprogram	Bachelor's Degree in Engineering for Industrial Technologies
Involved programs	Grado en Ingeniería en Tecnologías Industriales [Fourth year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	6,0 ECTS
Type	Optativa (Grado)
Department	Department of Electronics, Control and Communications
Coordinator	Aurelio García Cerrada
Office hours	Ask for an appointment

Teacher Information	
Teacher	
Name	Aurelio García Cerrada
Department	Department of Electronics, Control and Communications
Office	Alberto Aguilera 25 [D-218]
EMail	Aurelio.Garcia@iit.comillas.edu
Phone	2421
Profesores de laboratorio	
Teacher	
Name	Pablo García González
Department	Department of Electronics, Control and Communications
Office	Alberto Aguilera 25 [221]
EMail	pablo@comillas.edu
Phone	6105

DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

- A basic course on electric circuits (DC and AC)
- A basic course on Electrical Engineering
- Basic understanding of Fourier Analysis

Course contents

Contents

INTRODUCTION

1.1. Power Electronics: definition

1.2. A basic power converter

1.3 Circuits with periodic sources

1.4. Some definitions: power, energy, root-mean-square value, power factor and total harmonic distortion (THD)

ELECTRONIC POWER CONVERTERS

(The order of the following themes may change)

2. AC-DC CONVERTERS

2.1. Introduction: diodes and ideal switches

2.2. Uncontrolled single-phase AC-DC converter. Analysis and design. LC and C filters

2.3. Controlled single-phase AC-DC converter

2.4. Uncontrolled and controlled three-phase AC-DC converters

2.5. Application of AC-DC converters: HVDC-LCC

3. DC-DC CONVERTERS

3.1. Introduction. Transistors and ideal switches

3.2. Buck DC-DC converter. Analysis and design. Fundamental waveforms and losses

3.3. Boost DC-DC converter. Analysis and design. Fundamental waveforms and losses

3.4. Buck-Boost DC-DC converter. Analysis and design. Fundamental waveforms and losses

3.5. Generalising the analysis of DC-DC converters. Examples. Converters with galvanic isolation

3.6. Application of DC-DC converters: power supplies

3.7. Electromagnetic compatibility

4. CC-CA CONVERTERS

4.1. Square-wave single-phase converter

4.2. PWM single-phase converter: uni-polar and bi-polar PWM

4.3. Square-wave three-phase converter

4.4. PWM three-phase converter

4.5. Application of DC-AC converters: STATCOM and HVDC-VSC

LABORATORY

(The order of the following themes may change)

Session 1: CA-CC uncontrolled single-phase converter

Session 2: DC-DC buck converter

Session 3: DC-AC three-phase converter

EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Final exam	• Understanding of basic principles • Solving practical problems • Analysis of results • Presentation	70
Quizzes and submission of proposed exercises	• Understanding of basic principles • Problem solving • Analysis of results • Presentation	10
Laboratory exam and continuous evaluation of laboratory work	• Understanding of fundamentals • Problem solving skills • Analysis of results • Collaboration skills • Presentation of the work carried out	20

Grading

FINAL EXAM (FE) 70% of the final grade

CONTINUOUS EVALUATION (CEv) [Quizzes (Q) and number of submitted exercises (SE) among the total number of proposed exercises (PE)] 10% of the final grade

LABORATORY EVALUATION (Lab) [Laboratory Notebook (LN) and Laboratory Exam (LE)]

FE, Q, LN and LE will be graded between 0 and 10

The final grade will be calculated as follows:

If A=Q-10*(PE-SE)/PE

- Continuous evaluation Cev=A if A>0 Cev=0 if A≤0
- FINAL GRADE: 0.7*FE + 0.1 * Cev + 0.15 LE + 0.05 * LN

- Students will need FINAL GRADE ≥ 5 TO PASS THE SUBJECT

IMPORTANT NOTE: Attendance to lectures and laboratory sessions is compulsory, according to the rules of the School of Engineering.

Students may not be allowed to sit the ordinary exam if they miss too many lectures without justification. In addition, students may not be allowed to sit the ordinary exam and he extraordinary one if they miss too many laboratory sessions without justification.

ORDINARY

There are three main elements:

(1) FINAL EXAM (FE) 70% of the final grade

(2) CONTINUOUS EVALUATION (CEv) [Quizzes (Q) and number of submitted exercises (SE) among the total number of proposed exercises (PE)] 10% of the final grade

(3) LABORATORY EVALUATION (Lab) [Laboratory Notebook (LN) and Laboratory Exam (LE)]

Where FE, Q, LN and LE will be graded between 0 and 10

The final grade will be calculated as follows:

A=Q-10*(PE-SE)/PE

- Continuous evaluation Cev=A if A>0 Cev=0 if A≤0
- FINAL GRADE: 0.7*FE + 0.1 * Cev + 0.15 LE + 0.05 * LN
- Students will need FINAL GRADE ≥ 5 TO PASS THE SUBJECT

IMPORTANT NOTE: Attendance to lectures and laboratory sessions is compulsory, according to the rules of the School of Engineering.

Students may not be allowed to sit the ordinary exam if they miss too many lectures without justification. In addition, students may not be allowed to sit the ordinary exam and he extraordinary one if they miss too many laboratory sessions without justification.

EXTRAORDINARY

(1) FINAL EXTRAORDINARY EXAM (FE) 70% of the final grade

(2) CONTINUOUS EVALUATION (CEv) [Quizzes (Q) and number of submitted exercises (SE) among the total number of proposed exercises (PE)] 10% of the final grade,

This will be calculated as in the ordinary evaluation with the same data but students will be able to complete the proposed exercises not submitted before.

(3) LABORATORY EVALUATION (Lab) [Laboratory Notebook (LN) and Laboratory Exam (LE)]

LN will be maintained from the regular course. Students will have to repeat the laboratory exam only if they obtained less than 4 points in LE in the ordinary evaluation.

- FINAL GRADE: 0.7*FE + 0.1 * Cev + 0.15 LE + 0.05 * LN
- Students will need FINAL GRADE ≥ 5 TO PASS THE SUBJECT

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date

Personal study of lecture contents	After each lecture	
Problem solving	Each week	
Quiz preparation	At the end of each main theme	
Quizzes	Weeks 2, 6 and 9 (approx)	
Laboratory Notebook	Before and during each laboratory session	
Laboratory Exam	Week 14 (approx.)	

BIBLIOGRAPHY AND RESOURCES

Basic References

1. D.H. Hart. Power Electronics. McGraw-Hill, 2010
2. Mohan, N.; Undeland, T.M. and Robbins, W.P. Power Electronics: Converters, Applications and Design. Any edition. Wiley, 2003 (3rd edition)

Complementary References

- Mohan, N. Power Electronics. A first course. Wiley. 2011.
- Erickson, R.W; Maksimovic, D. Fundamentals of Power Electronics. Springer. 2001.