SUBJECT TEACHING GUIDE

G729 - Electronic Power Conversion

Degree in Industrial Technologies Engineering

Academic year 2022-2023

1. IDENTIFYING DATA					
Degree	Degree in Industrial Technologies Engineering			Type and Year	Optional. Year 4
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Subject Area: Electronics and Automation Optional Module				
Course unit title and code	G729 - Electronic Power Conversion				
Number of ECTS credits allocated	6	Term		Semester based (1)	
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. TECNOLOGIA ELECTRONICA E INGENIERIA DE SISTEMAS Y AUTOMATICA
Name of lecturer	FRANCISCO JAVIER AZCONDO SANCHEZ
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Other lecturers	FRANCISCO JAVIER DIAZ RODRIGUEZ CHRISTIAN BRAÑAS REYES

3.1 LEARNING OUTCOMES
- Students learn the fundamentals and operating principles of the switched-mode power converters
- Students are equipped with design, modeling and prototyping skills of magnetic components applied to power electronic converters
- Students are equipped with power electronic converters design and test skills
- Students learn key parameters to assess the advances of power electronics devices technology
- Students learn the principle of large and small-signal modeling of power electronic converters

4. OBJECTIVES
Present the operation and modeling principles of power electronics converters
Equip the students with practical magnetic components for power converters design skills
In the course, the key parameters to assess the basic power electronic topologies are taught
Introduce the power electronics devices technology
The dynamic average modeling and controller design techniques of power converters are presented in the course

6. COURSE ORGANIZATION	
	CONTENTS
1	1.- Introduction: Power conversion, power electronics applications, power electronics elements, course summary. 2.- Principles of steady-state operation of power electronic converters. Inductor volt-seconds balance, charge balance in capacitors, small-ripple approximation, examples, ripple estimation in converter with two-pole low pass filter, summary. 3.- Steady-state modeling, power loss, efficiency: DC transformer model, power loss in inductors, developing of the equivalent model, input port analysis, example. summary.
2	4.- Basic theory of magnetic components. Revision, transformer model, power loss in magnetic components, Eddy currents, Skin and proximity effects, type of magnetic materials. 5.- Inductor design principles and sequence. Specification of inductor design for filters. Magnetic design with multiple windings using the Kg method, examples, summary 6.- Transformer design principles and sequence. Basic specifications for the design of transformers. Design using the Kgf method, examples, design of ac inductors, summary.
3	7.- Switch-mode power converter circuits: Derivation of the basic power topologies, isolation transformer, assessment and design of power converters, summary.
4	8.- Power electronic devices: Application of static switches, map of power devices technology, conduction and switching power loss. Summary
5	9.- Discontinuous conduction mode: Origin of the discontinuous conduction mode and limit between continuous and discontinuous conduction mode, analysis of the output voltage vs. input voltage relation, example, summary.
6	10.- Small-signal ac model of the power electronic converters: Basic approximation to the small-signal ac model, state-variable modeling, average circuit modeling, switching-cell modeling, canonical model, pulse-width modulator model. summary. 11.- Transfer functions of power converters: Bode diagram revision, analysis of the transfer functions of power converters, graphic study of the transfer functions, experimental measurement of power converters transfer functions and characteristic impedances, summary.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Lab practices	Laboratory evaluation	No	Yes	30,00
Students solve study cases using simulation tools and otrer exam exercises. Results are presented in a written document.	Written exam	Yes	Yes	40,00
Work assignments	Work	No	No	30,00
TOTAL				100,00

Observations

The class exercises are not recoverable since they are part of the monitoring of learning and serve to motivate the tutorials and adapt the quantity and orientation of the content of the classes.
In the event that the health criteria make it necessary, the evaluation tests will be carried out following the mixed teaching format, face-to-face in the classroom and outside of it. In the most extreme case that the attendance of all students and teachers at the center is impossible or inconvenient, the evaluation tests will be developed using telematic means. In these cases, the content of the tests, being similar to the face-to-face case, would be totally or partially individualized.
In the case of a new health alert for COVID-19 make it impossible to carry out the evaluation in person, the remote evaluation of these same works, practical laboratory exercises and written tests is foreseen, for each student.

Observations for part-time students

Since 60% of the total grading is achieved with activities developed along with the regular and lab sessions, the assessment criteria for part time students is the same as for the other students

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

R. W. Erickson and D. Maksimovic. Fundamentals of Power Electronics, 3rd Ed. Springer 2020

N. Mohan, T.M. Undeland, W.P. Robbins. Power Electronics: Converters, Applications and Design. John Wiley & Sons. 2003. 3ª Edición

A. Barrado, A. Lázaro. Problemas de Electrónica de Potencia. Pearson Prentice Hall. 2007