SUBJECT TEACHING GUIDE

M868 - Advanced Electronic Techniques for Efficient Conversion of Electrical Energy
Master's Degree in Industrial Engineering Research

Academic year 2021-2022

1. IDENTIFYING DATA					
Degree	Master's Degree in Industrial Engineering Research			Type and Year	Optional. Year 1
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Electroenergetic Module Electromechanic / Mechatronics Module Advanced Techniques in Electronic Design				
Course unit title and code	M868 - Advanced Electronic Techniques for Efficient Conversion of Electrical Energy				
Number of ECTS credits allocated	5	Term		Semester based (2)	
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	ROSARIO CASANUEVA ARPIDE CHRISTIAN BRAÑAS REYES

3.1 LEARNING OUTCOMES
- Get knowledge of the international reserch activity in power electronics
- Students will understand the large and small-signal behavior of the modern power converters topologies and the digital nature of the switched-mode power conversion techniques.
- The students will learn to model and design switched-mode power converters systems
- The students will learn the operation principles of resonant converters and how they can improve industrial process where they find application
- Students will develop practical knowledge in prototype design and building details of switched-mode power supplies including resonant converters
- Students will be able to face the design of power electronic systems under real industrial specifications.
- Student will be able to assess new power devices and magnetic materials along with their technical applications.
- Understand the operating principles of the resonant converters and the improvement of industrial processes in which they find application

4. OBJECTIVES
Students will learn about the objecties of the present research activity in power electronics.
Students will understand the small and large signal behavior of the power converter topologies and the digital nature of the switched-mode power conversion techniques.
Students wil be equiped with modeling and design of switched-mode power converters skills.
Students will understand the operation principles of resonant converters and how they can improve the industrial process where they find application.
Students will develop practical knowledge in power supply design and prototype building details, including resonant converters.
Students will be equipped with the capacity of designing power converters under industrial specifications.
Students will be able to evaluate new power devices and magnetic materials and their possible applications.
Students will develop evaluation capabilities of emerging technologies to solve new industrial specifications.
Students will increase their experience in writing and presenting techncal information to other colleagues.
Students will have experience of doing individual and group work. They wil develop human and material resource management skills.
Students will improve their writing and speaking skills.

6. COURSE ORGANIZATION

	CONTENTS
1	1. Advanced concepts in power electronic converters - Averaged models in continuous and discontinuous conduction mode - Converters model with current-mode control - Side band frequency effects - AC - DC and DC - AC converters
2	2. Control of power electronic converters - Analog control - Digital control
3	3. Resonant inverters - Justification, applications, properties. Topologies and operation modes - Resonant inverters analysis: characteristics and comparison among topologies - Applications of the resonant converters: electrical discharge machining, welding, lighting
4	4.- Modern power electronic devices - New MOSFETs and IGBTs - SiC and GaN technology - Modern magnetic materials for inductors and transformers
5	1.1. Advanced concepts in Power Electronic Converters - Review of average models in continuous and discontinuous conduction mode - Modeling of current programmed controlled converters - Sideband frequencies effect - AC - DC y DC - AC converters

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Continuous assessment	Work	No	Yes	100,00
TOTAL				100,00

Observations

Students will receive work assignments to: Study key papers on the syllabus topics. Analyze, model and simulate with specific software and performing practical lab measurements up-to-date power electronics converters. The development of this training tasks needs using English written documents. According to the students first language instructor will use English and Spanish in class.
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 customized for each student.
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.

Observations for part-time students

Since 70% of the grading corresponds to activities presented and followed along with the regular classes and since the final exam consist of the presentation of practical case study also discussed in the classes, the assessment criteria for part time students is the same as for the other students.
Part-time students with incompatible schedules receive direct personal attention or by telematic means on the contents and continuous evaluation. The virtual classroom facilitates access to information and continuous assessment tests.

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
- R. W. Erickson, D. Maksimovic. Fundamentals of Power Electronics 2nd Ed. Kluwer Academic Publisher. 2001
- N. Mohan, T.M. Undeland, W.P. Robbins. Power Electronics: Converters, Applications and Design. John Wiley & Sons. 2003. 3ª Edición
- Philip T. Krein, Elements of Power Electronics Oxford University Press. 1998
- John G. Kassakian, Martin F. Schlecht, and George C. Verghese, Principles of Power Electronics Addison-Wesley, 1991
- M. K. Kazimierczuk, D. Czarkowski, Resonant Power Converters. New York: Wiley Interscience Publication, 1995.