Electronic power converters optimization

Academic Year: (2019 / 2020) **Review date: 28-04-2016**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: LAZARO BLANCO, ANTONIO

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Some subject related to Fundamentals of Power Electronics

OBJECTIVES

BASIC COMPETENCES

- Students should be able to apply their knowledge and their problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.

- Students should be able to integrate knowledge and handle complexity, and formulate judgments based on information that, being incomplete or limited, includes thoughts about the social and ethical responsibilities related to the application of their knowledge and judgments.

GENERAL COMPETENCES

- Develop concise, clear and justified documentation, and specify the work to be done for the development, integration and implementation of complex and high added value electronic systems.

- Ability to devise, design, implement and maintain an electronic system in a specific application.

- Acquire teamwork skills within a multidisciplinary contex.

- Adopt the scientific method as a fundamental working tool in both professional and research environments.

SPECIFIC COMPETENCES

- Ability to use advanced tools, techniques and methodologies for the design of electronic systems or subsystems.

- Ability to design a device, system or application that meets a given specification, using a systematic and multidisciplinary approach, and integrating modules and advanced tools that are specific to the field of Electronic Engineering.

- Ability to solve practical problems related to the elements interaction within and outside of an electronic system. It will be considered signal interferences, electromagnetic compatibility and thermal management, during the design stages, pre-manufacturing stage and also when re-design was required.

- Students should be able to identify those figures of merit and comparison techniques needed to obtain the best solutions to scientific and technological challenges in the field of Electronic Engineering and its applications.

- Ability to apply optimization techniques for the development of electronic circuits and subsystems.

LEARNING RESULTS

At the end of the subject, the student will achieve:

- to know which is the most suitable converter for each application, taking into account a given set of specifications.

- to design effectively magnetic components (inductors and transformers). In addition the student will be able to select the best power semiconductors and capacitors for each application and specifications.

- to implement optimization techniques in order to obtain the best solution form a global point of view.

- to design adequately the elements that configures the thermal management of the power converter.

- to design those circuits that converts a conceptual design into a product (protections, isolation elements, mechanical enclosure, etc.)

DESCRIPTION OF CONTENTS: PROGRAMME

1. Power topology selection
1.1 Fundamentals of switching dc-dc converters
1.2 Selection criteria and applications
1.2.1 DC ¿ DC converters
1.2.2 AC ¿ DC converters
1.2.3 DC ¿ AC inverters

2. Design and selection of passive components and power semiconductors
2.1 Power semiconductors selection
2.1.1 Power losses calculations: conduction losses and switching losses
2.2 Capacitors selection
2.3 Magnetic component design for low, medium and high frequency applications
2.3.1 Core material selection
2.3.2 Type of conductor selection
2.3.3 Inductor design
2.3.4 transformers design

3. Optimization techniques applied to power converters

4. Industrial realization of the power converter
4.1 Thermal management
4.2 Protection devices and techniques
4.3 MOSFET and IGBT drivers
4.4 Mechanical enclosures and IP code

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES

- Theoretical classes
- Practical Classes
- Lab sessions (development of simulations in computer rooms)
- Tutoring hours
- Teamwork
- Individual work of the student

METHODOLOGY

- Classroom lessons by means of presentations and simulations. In these lessons, the main concepts of the subject will be developed by teacher and complementary references will be given to students

- Practical case studies, problems resolution, etc. will be proposed by teacher to be solve individually or in groups

- Project and reports development, individually or group

ASSESSMENT SYSTEM

Ordinary Examination:
- Group and or individual work, 60% of final score
- Final exam, 40% of final score

Extraordinary Examination:
The assessment could be done according to the continuous evaluation system taking into account the same score percentages used in the ordinary examination. A second option is a final exam reaching the 100% of the final mark.

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

BASIC BIBLIOGRAPHY

- A. I. PRESSMAN Switching Power Supply Design, McGraw-Hill, 1998
- K. BILLINGS Switching power supply handbook, Mc Graw Hill , 2011
- N. MOHAN, T.M. UNDELAND, W.P. ROBBINS Power electronics, converters, applications and design, John Wiley & Sons, 2003
- W.G. HURLEY, W.H. WÖLFLE Transformers and Inductors for Power Electronics, Wiley, 2013

ADDITIONAL BIBLIOGRAPHY

- D.G. HOLMES, T.A. LIPO Pulse Width Modulation for Power Converters, IEEE PRESS ¿ Wiley Interscience, 2003
- M.K. KAZIMIERCZUK Pulse-Width Modulated DC ¿ DC Power Converters, Wiley, 2008
- R.W. ERICKSON, D. MAKSIMOVIC Fundamentals of Power Electronics, Kluwer Academic Publishers, 2001
- VAN DEN BOSSCHE, V. C. VALCHEV Inductors and transformers for power electronics, CRC PRESS, 2005