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Power electronics systems

Academic Year: (2019 / 2020) **Review date: 01/05/2020 18:30:47**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: BARRADO BAUTISTA, ANDRES

Type: Electives ECTS Credits : 6.0

Year : 4 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Control Engeeniering
Power Electronics

OBJECTIVES

By the end of this course, students will be able:
- To 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
- An understanding of applicable techniques and methods in power electronics, and of their limitations

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In addition, Power Electronic Systems is presented as a course eminently practical and with real application, where students will acquire the following specific technical competencies:
- Knowledge of modeling techniques that can be applied to electronic circuits and power systems.
- Modeling of equipment and systems
- Design of control loops
- Design of typical power converters and power distribution systems for different applications: Aerospace, Railway, Electrical Automotive, Solar, Lighting, etc.
- Conditioning of new energy sources.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction.
   1.1. Power electronics systems
   1.2. Applications
2. Fundamentals of power electronics
   2.1. Electrical concepts
   2.2. Electrical components
   2.3. Types of power conversion
3. Dynamics of the converters and systems.
   3.1. Steady state and transient state.
   3.2. Small signal and large signal.
   3.3. Linear and non linear elements.
4. Converters modeling.
   4.1. Types of modeling.
   4.2. Simulation-oriented modelling.

4.3. Modelling of a Buck and Boost converters.
4.4. Modelling of the compensator, modulator and sensing blocks.ç
4.5. Injected and absorbed current method. Modelling of a Flyback converter in DCM.
5. Converter control loop design.
5.1. Voltage-mode control.
5.2. Current-mode control.
5.3. Average current-mode control.
5.4. Compensators design.
5.5. Control of a Buck converter and a Bidirectional converter.
6. Power Factor Corrector (AC-DC).
6.1. Power stage design.
6.2. Inner current loop design.
6.3. Outer voltage loop design.
6.4. Modelling and control of a Three phase rectifier.
7. Inverters.
7.1. Power stage design.
7.2. Control stage design.
7.3. Compensator design.
8. Regulations.
8.1. Electrical safety and grounding regulations.
8.2. EMC regulations about low-frequency conducted disturbances.
8.3. EMC regulations about conducted and radiated high frequencies.
9. Laboratory practices:
9.1. Switched-mode power supplies: DC-DC converter.
9.2. Power supply for PC: Power Factor Corrector.
9.3. CA-CC power converter for LED luminaries.
9.4. Solar plant: Grid-connected inverter.

LEARNING ACTIVITIES AND METHODOLOGY

The teaching methodology will include:
- Lectures, which will include the knowledge that students should acquire. To facilitate their development students will receive class notes and key reference books, which will allow them to complete those issues which are more interested
- Practical aimed at solving exercises. These classes are supplemented by solving exercises by students that will serve to assess their knowledge and acquire the necessary skills.
- Lab, where students simulate or design, assemble and test an electronic system aimed at solving a particular problem. In some of these practices, students will handle electronic instrumentation equipment and the main electronic components under study.

ASSESSMENT SYSTEM

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

The evaluation will be based on the following criteria:
- Resolution of problems and exercises
- Practice Laboratory will assess the knowledge acquired by students in the management of electronic instrumentation equipment and the electronics components object of study, or in the simulation of systems in computer rooms.
- Final exam which will assess the knowledge acquired by students.
- A minimum mark will be required in the written assessment.

BASIC BIBLIOGRAPHY

- ANDRÉS BARRADO, ANTONIO LÁZARO PROBLEMAS DE ELECTRÓNICA DE POTENCIA, PEARSON EDUCACIÓN, PRENTICE HALL, , 2007

- Amirnaser Yazdani, Reza Iravani Voltage-Sourced Converters in Power Systems: Modeling, Control, and Application, WILEY, 2010

- D.G. HOLMES, T.A. LIPO. Pulse Width Modulation for Power Converters, IEEE PRESS - Wiley Interscience, 2003

- DANIEL W. HART Electrónica de Potencia, Ed. Prentice Hall, 2001

- MOHAN, N., UNDELAND, T.M., ROBBINS, W.P. Power electronics, converters, applications and design, John Wiley & Sons, 2003

- R.W. Erickson Fundamentals of power Electronics, Kluwer Academic Publishers, 2001

- RASHID, M.H. Power Electronics: circuits, devices and applications,, Prentice-Hall, 1993

- Salvador Martínez y Juan Andrés Gualda Electrónica de Potencia: Componentes, topologías y equipos, Thomson, 2006