EE 413 – Power Electronics

Designation: EE elective course for electrical engineering majors.

University Bulletin Description: EE 413: (3) Switch-mode electrical power converters. Electrical characteristics and thermal limits of semiconductor switches.
Prerequisites: EE 310, EE 350.

Prerequisites by Topics:
1. Understanding and the ability to use differential equations, linear algebra, and complex variables in the modeling and analysis of linear circuits.
2. Understanding and the ability to apply Fourier analysis to periodic signals.
3. Understanding and the ability to analyze circuits containing semiconductor devices.
4. Familiarity with the use of MATLAB for signal analysis.
5. Proficiency in the use of basic test equipment (oscilloscope, function generator, power supply).

Textbook/Required Materials:
Power Electronics, 3nd ed., Mohan, Undeland, and Robbins, Wiley & Sons, 2003

Learning Outcomes:
This course provides an introduction to the modeling and analysis of switch-mode power converters. Through lecture, laboratory, and out-of-class assignments, students are provided learning experiences that enable them to:
1. Analyze and design ac-to-dc circuits.
2. Analyze and design dc-to-dc converters.
3. Understand the behavior of semiconductor devices operated as power switches.
4. Become proficient with computer skills (e.g., PSPICE and MATLAB) for the analysis and design of power electronic circuits

Topics:
1. Overview of power electronics
2. Semiconductor switch modeling
3. Magnetic circuits and transformers
4. ac-to-dc converters
5. dc-to-dc converters
6. Power supply design

Class/laboratory schedule: Three 50-minute lectures per week

Computer usage:
1. PSPICE is used to facilitate analysis and design of circuits in the laboratory.
2. MATLAB to produce steady-state characteristics for dc-to-dc and ac-to-dc converters.

Laboratory Projects/Assignments:
1. Experiments are performed to validate models of circuits and devices.
2. Laboratory experiments involve the use of basic test equipment (digital oscilloscope, function generator, power supply) and a personal computer that are part of each laboratory workstation.

Contribution to Meeting the Requirements of Criterion 5. Curriculum:
This course contributes to both the engineering topics and design components.
This course provides a design emphasis in the area of power electronic circuits. Topics pertaining to economics and manufacturability are considered in the context of electronic circuit design and construction.

Relationship to Program Outcomes:

O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
O.1.3. Graduates will have attained computer proficiency.
O.2.1. Graduates will understand how to analyze and design simple electrical/electronic circuits.
O.2.2. Graduates will understand electronic devices.
O.2.3. Graduates will understand the basic concepts of linear systems and how they interact with continuous-time signals.
O.3.1. Graduates will have in-depth technical knowledge in one or more areas of specialization.
O.3.2. Graduates will have practical understanding of the major electrical engineering concepts and demonstrate application of their theoretical knowledge of the concepts.
O.4.1. Graduates will interact with industry both within and outside of a classroom setting.
O.4.2. Graduates will develop an appreciation of continuing educational and professional development.
O.6. Graduates will appreciate their role as engineers in society.

Prepared by: Jeffrey S. Mayer **Date:** April 10, 2008