EEE498/591 - Power Electronics – Spring 2008

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Class hours: MW 1:40 - 2:55PM, Brckyrd 210 (also on internet)

Power electronics is a critical, multi-disciplinary technology that uses electronic devices for efficient control and conversion of electric power. It covers a truly wide spectrum of applications including power supplies for all electronic equipment ranging from cell phones to mainframe computers, interface of distributed energy resources such as fuel cells, photovoltaics and wind, motion control, electric cars and other automotive applications, and modern lighting. As such, skilled power electronics engineers are in great demand in various industries.

This course teaches the fundamentals of power electronics in the context of exciting new applications. The focus of this course is on design-oriented analysis of power electronic converters for various applications such that students can be productive in industry right from the beginning. It also provides solid theoretical background to prepare students for advanced courses in this field. PSpice based simulations will be used extensively to reinforce the basic concepts, and as a design tool as well.

Pre-requisite: EEE 202 (Circuits I), EEE 203 (Signals & Systems I) and familiarity with PSpice

Textbook: N. Mohan, "First course on *Power Electronics,"* MNPERE publishers, 2005

- **Basic principles of switch-mode power conversion:** Introduction to switching converters, concept of steady state, volt-second and ampere-second balance, ideal switches
- **Analysis of basic dc-dc converters (non-isolated) using a building-block approach:** Analysis and design of buck, boost, buck-boost and SEPIC converters, based on the model of a power pole
- **Modeling and control of dc-dc converters:** Review of linear control theory, small-signal average model of converters, control design techniques – voltage mode and current mode control, brief discussion on digital control
- **Power management:** Switching regulators for modern processors and telecom, voltage regulator modules (VRM), multi-phase converters
- **Switch mode power supplies with isolation:** Design and analysis of forward, fly-back, and full-bridge converters, introduction to soft switching, magnetics design, practical issues such as thermal management, EMI, control ICs
- **Voltage source inverters:** Topology, PWM techniques and control methods for dc-ac inverters
- **Grid interface of renewable resources:** Power converters and control methods for interfacing photovoltaics (PV) and wind energy with grid
- **Modern rectifiers:** Power quality issues, power factor correction circuits (PFC)
- **Practical aspects:** Device selection, control ICs, EMI, layout, thermal management
- **Modern applications of power electronic converters**