

14:332:446, Topics in ECE, index 15322 for Spring 2015
Subtitle: Energy Efficient Power Electronic Devices
Tuesday and Thursday 6th period (5:00PM to 6:20PM) SEC-203
Instructor: Dr. Jian Zhao <jzhao@ece.rutgers.edu>
Pre-Requisites: 332:361 Electronic Devices & 332:366 Digital Electronics

Objective: Introduce students to the new generation of energy-efficient power electronic devices and provide students the insight useful for understanding and analyzing those devices. Silicon power electronic devices are fast approaching their performance limits set by silicon's fundamental material properties. A new generation of semiconductor materials having a wider energy bandgap has emerged which makes energy-efficient electronic, especially power electronic, devices possible. These devices are capable of drastic reduction of switching and conduction losses simultaneously as well as operation under higher temperatures, making power systems considerably smaller, lighter, cheaper and more robust.

Detail Description: This course will focus on energy-efficient power electronic device design and analysis. As a prerequisite, students should have a good understanding of semiconductor materials and electronic devices including concepts of charge carriers of holes and electrons, carrier mobility, energy bandgap, depletion regions and built-in potentials in pn junctions and MOSFET as well as bipolar transistors. Topics covered include

1. Key properties of wide bandgap semiconductors
2. Edge Termination design for high efficiency power devices
3. Energy-efficient design and analysis of power rectifiers
4. Energy-efficient design and analysis of unipolar power switches
5. Energy-efficient design and analysis of bipolar power switches

Students who successfully complete this course should have a good understanding of the key design issues, including both physical and thermal aspects, and be able to design, at an introductory level, energy-efficient unipolar and bipolar power devices.

Textbook: << Fundamentals of Power Semiconductor Devices>> by B. J. Baliga, Springer Science-2008. ISBN 978-0-387-47313-0

Grading:

Homework Assignments and Quizzes (20%)

Midterms (35%)

Final Exam (45%)