Rutgers University, Department of Electrical and Computer Engineering
ABET COURSE SYLLABUS
COURSE: 14:332:460

Course Catalog Description:	14:332:366 Power Electronics (3) Principles of power electronics. Including understanding of power semiconductor devices, passive components, basic switching circuits, AC/DC, DC/DC, DC/AC converters and their applications.
Pre-Requisite Courses:	14:332:361
Co-Requisite Courses:	None
Pre-Requisite by Topic:	1. Electrical circuit theory 2. Semiconductor devices 3. Basic electromagnetic theory
Textbook & Materials:	I. Batarseh, Power Electronics Circuits, Wiley, 2003
References:	1. N. Mohan, T. Undeland, W. Robbins, Power Electronics, Wiley, 3rd Edition, 2003 2. M. Rashid, Power Electronics, Prentice-Hall, 3rd Edition, 2003
Overall Educational Objective:	1. To introduce students the basic theory of power semiconductor devices and passive components, their practical application in power electronics. 2. To familiarize the operation principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications. 3. To provide the basis for further study of power electronics circuits and systems.
Course Learning Outcomes:	A student who successfully fulfills the course requirements will have demonstrated: 1. An ability to understand basic operation of various power semiconductor devices and passive components. 2. An ability to understand the basic principle of switching circuits. 3. An ability to analyze and design an AC/DC rectifier circuit. 4. An ability to analyze and design DC/DC converter circuits. 5. An ability to analyze DC/AC inverter circuit. 6. An ability to understand the role power electronics play in the improvement of energy usage efficiency and the development of renewable energy technologies.
How Course Outcomes are Assessed:	1. Five to Seven Homework Assignments (10 %) 2. Four Quizzes (16 %)

3. Mid-Term Exams (20 %)
4. Lab project (12 %)
5. Final Exam (42 %)

N = none S = Supportive H = highly related

Outcome	Level	Proficiency assessed by
(a) an ability to apply knowledge of Mathematics, science, and engineering	H	HW Problems, Quizzes, Lab, Exams
(b) an ability to design and conduct experiments and interpret data	H	Design problems in HW, Lab, Exams
(c) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	S	HW Problems
(d) an ability to function as part of a multi-disciplinary team	S	Each Experiment done by a team
(e) an ability to identify, formulate, and solve ECE problems	H	HW Problems, Quizzes, Lab, Exams
(f) an understanding of professional and ethical responsibility	S	Conducting experiments, report the results
(g) an ability to communicate in written and oral form	S	Laboratory reports
(h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context	N	
(i) a recognition of the need for, and an ability to engage in life-long learning	S	Lectures, subsequent courses
(j) a knowledge of contemporary issues	N	
(k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice	H	HW Problems, Extensive use of PSpice simulation, Lab
Basic disciplines in Electrical Engineering	H	HW, Quizzes, Lab, Exams
Depth in Electrical Engineering	S	HW, Quizzes, Lab, Exams
Basic disciplines in Computer Engineering	N	
Depth in Computer Engineering	N	
Laboratory equipment and software tools	S	Lab experiments, PSpice simulation
Variety of instruction formats	S	Lectures, Office hour discussions, lab instruction

Topics Covered week by week:

Week 1 Introduction to power electronics, elementary switching circuit, power semiconductor devices, device loss calculation.

Week 2-3 Operating mechanism of power devices including diodes, BJTs, MOSFETs, IGBTs, SCRs and GTOs. Their advantage/disadvantages and applications.

Week 4-5 Power and harmonics concepts, power factor, Fourier analysis, harmonic distortion, Passive components.

Week 6-7 Uncontrolled rectifiers including single phase half-wave, full-wave rectifiers, three phase rectifier. Midterm.

Week 7-8 Controlled rectifiers, half-wave, full-wave and three-phase controlled rectifiers.

Week 9-11 Non-isolated DC-DC converters, buck (single-ended chopper) converter, boost, buck-boost and cuk converters, switching loss and efficiency estimation.

Week 11-12 Isolated switch mode power supply, forward converter, fly-back converter, half-bridge.

Week 13-14 DC-AC inversion, pulse-width-modulation (PWM) techniques, harmonic reduction, three-phase inverter.

Week 14-15 Review of advanced power sources, world energy review, fuel cell power, wind power, solar power. Course review.

Week 16 Final exam.

Computer Usage: Simulations using *PSpice*.

Laboratory Experiences: A lab component requiring students to design, construct, diagnose and testing of power electronics converters is included.

Design Experiences:	~25% of the homework. Many homework problems are design-oriented problems. In conjunction with the Lab component, students will learn the PSpice software for simulation and design of the power electronics circuits with power MOSFETs, power capacitors and inductors. ~25% problems in the Exams are design related.
Independent Learning Experiences:	1. Homework assignment 2. Computer-aided simulation 3. Lab reports 4. Testing (Quizzes, Exams)
Contribution to the Professional Component:	1. College-level mathematics and basic sciences: 0.25 credit hours 2. Engineering Topics (Science and/or Design): 2.75 credit hours 3. General Education: 0 credit hours Total credits: 3
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Date:	August 2007