

EE432/537 Power Electronics-(3 credits)

**College of Engineering
Klipsch School of Electrical and Computer Engineering
New Mexico State University**

Date and Time: Spring 2007: Class T-Th 10:20 AM-11:45 AM
 Lab Open Lab Monday, Tuesday and Friday
Room: Class: T&B104 Lab: Rm. T&B 100B
Instructor: Satish J. Ranade T&B112
Office Hours: MW 2:30-4PM or by appointment
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Course Web site: <http://www.ece.nmsu.edu/~sranade/>

Course Description from the Undergraduate Course Catalog –

EE432/537 Power Electronics-(3 credits)

Basic principles of power electronics and its application to power supplies, electric machines and power systems.

Prerequisite: C or better in EE221, EE332 Coerequisite: EE311, EE341

Textbook and other Required Materials:

Text: None

The following reference texts will be made available to you in Rm. 100B and the Branson Library
Batarseh “Power Electronic Circuits”, Wiley, Hoboken, NJ, 2004
Krein “Elements of Power Electronics”, Oxford, New York, NY, 1998
Mohan, Undelaand and Robbins, “ Power Electronics”, Wiley, New York, NY, 1995

Course Objectives:

- To introduce students to electronic power control
- To develop an understanding of the basic structure and analysis of power electronic systems
- To explore and illustrate design and application.
- Writing laboratory reports and project documentation
- Presenting a team laboratory project in front of peers

Graduate Students are expected to complete a more extensive project.

Contribution of EE 432 to Meeting the Professional Component:

As an elective in the energy systems area and a depth course in the electronics area, Power Electronics challenges students to learn the principles of power electronics and to apply these to the design of practical power electronic systems. Students develop skills gained in previous courses: circuit theory; power systems, electronics, signals; controls and computers. Students completing this course are ready for employment as power or power electronics engineers.

Relationship of the Course to Program Objectives:

Through reading, homework problems, circuit simulations and layouts, exams, laboratory experience, and team projects students demonstrate an ability to

- apply knowledge of mathematics science and engineering [I.(a)]
- design a system to meet desired needs [I.(c)]
- formulate, and solve engineering problems [I.(e)]
- communicate effectively [I.(g)]
- engage in lifelong learning [I.(i)]
- use techniques, skills, and tools of practicing electrical engineers [I.(k)]
- analyze and design complex electronic systems containing hardware [II. (g)]
- use computers to solve engineering problems [III. (a)]
- apply critical thinking skills to solve problems [III. (b)]
- obtain meaningful employment or continue with graduate education [III.(e)]

STUDENTS WITH DISABILITIES: If you have (or believe you have) a disability and would benefit from classroom accommodation(s), please contact the Services for Students with Disabilities (SSD)]

Student Responsibilities:

1. Register with SSD and obtain accommodation documents early in the semester;
2. Deliver the completed accommodation and testing form(s) to the instructor(s) within the first two weeks of beginning of classes (or within one week of the date services are to commence);
3. Retrieve the signed form(s) from faculty and return to SSD within (5) days of the receipt from faculty and at least one week before any scheduled exam; and,
4. Contact the SSD Office if the services/accommodations requested are not being provided, not meeting your needs, or if additional accommodations are needed. Do not wait until you receive a failing grade. Retroactive accommodations cannot be considered.

Faculty Responsibilities

1. Sign the *ACCOMMODATION REQUEST FORM* and *TESTING ACCOMMODATION FORM* (when presented), retain a copy, and return the original to the student within five (5) working days of receipt;
2. Contact SSD immediately if there are any questions or disputes regarding accommodation(s), disruptive behavior, etc.; and,
3. Refer the student to SSD for any additional accommodations.

Accommodations: SSD Office, 646-6840 (Corbett Center, room 244)

Discrimination: Office for Institutional Equity, Mr. Paul Gayle-Smith, 646-3635, O'Loughlin House

Prepared by: Satish J. Ranade, January 18, 2007

Schedule

Week	Topic	Section	Homework
1 (1/18)	Introduction to Power Electronics Applications; General structure of power electronic systems; Use of electronic devices as switches		
2-5(1/22))	Basic Concepts/Circuit Analysis Analysis of RLC circuits with switches; Analytical solutions and simulation; Periodic Steady state solutions Power calculations; Fourier Series;		
6-7(2/12)	Rectifiers (ac-dc) Single and three-phase rectifiers; capacitive filters;		
8-10(3/5)	dc-dc Converters Linear regulators and switch mode conversion (Pulse width modulation) Buck, Boost, Buck-Boost and related converters; Isolated converters Design Considerations-simple dc power supply.		
10-11(3/26)	Converters Single and three-phase rectifiers; capacitive filters; Controlled rectifier/inverter. HVDC transmission; dc motor control Ac voltage controllers		
12-14(4/9)	Inverters Basic principles; sinusoidal PWM. Applications		
15(4/30)	Other topics. Project Presentations		

LABORATORY

You will be required to complete five laboratory experiments as listed below. From time to time we will use the Thursday lecture hour to review experiments in the laboratory or to work on the project.

1. Circuit principles: RLC-Diode Voltage doubler
2. Rectifier and Controlled Rectifier
3. dc-dc converter
4. dc-ac converter
5. dc motor control

The laboratory will be available Mondays, Tuesdays and Fridays. The instructor will be available by appointment.

PROJECT

A formal design project is required. The project can be related to a Capstone Design class.

Sample Projects:

1. ac-dc power supply
2. dc motor controller
3. static transfer switch
4. dc transmission line

The tentative schedule for the project is as follows

1. February 15: Select project; Submit two-page proposal
2. March 15: First milestone: Develop conceptual design, Submit detailed specifications and time table.
3. April 1: Preliminary design; order parts if needed.
4. April 15: Second milestone. Detailed Design report; Prototype demo if appropriate.
5. Week of May 1: Final report and presentation

Each step counts towards 20 % of project grade.

GRADING

Homework	15%
Tests (3)	40%
Quizzes (?)	5%
Laboratory(5)	20%
Project	20%

Course grade: A \geq 90%, B \geq 80%, C \geq 70%; D \geq 60%; F < 60%

Extra Credit: 1/2 point will be added to your semester total for any of the following activities:

- A. *Active* participation in professional societies; give me a one page report describing your role
- B. Attend seminars related to electrical engineering and write a one-page report summarizing the seminar.

Maximum extra credit is 2 points.

POLICIES

1. Feel free to collaborate on homework. No late homework.
2. Tests will focus on the material studied in each preceding period.
3. All work on tests and quizzes must be your own. You are allowed two-sides of a 8.5x11 cheat sheet for formulas for tests and quizzes. Do not put solved examples on the cheat sheet. If you do, you will receive a zero on the test. Turn cheat sheet in with test.
4. There will be no makeup quizzes.
5. Makeup tests can be given if you have a medical excuse, or if you need to miss class for good reason and make arrangements ahead of time
6. Arrangements can be made for makeup laboratory sessions if you have a valid reason (medical, family, out-of-town).
7. Incomplete grades will be assigned only under exceptional circumstances (e.g., medical, family), with proper and timely documentation, and only if you have a passing grade at mid-semester. Per NMSU rules an Incomplete cannot be given to avoid a bad or failing grade.
8. **Failure to follow safety and other specified procedures in laboratory will result in an F grade for the course**