



**ECE Department**  
**ECE556 – Power Electronics: Linear and Switching Power**  
**Supplies**  
**Winter 2008-09**

**Instructor Information**

**Instructor:** Marc E. Herniter  
**Office Hours :** [See Schedule.](#)  
**Office Phone Number :** 877-8512  
**Office Number :** C211  
**WEB Address:** <http://www.rose-hulman.edu/~herniter>  
**E-mail:** [Marc.Herniter@IEEE.org](mailto:Marc.Herniter@IEEE.org)

**PREREQUISITE:** [ECE 351](#)

**REQUIRED MATERIALS:**

**OPTIONAL TEXTBOOK:** *Schematic Capture With Cadence PSpice, 2<sup>nd</sup> Edition*, M.E. Herniter, Prentice Hall, 2003. ISBN: 0-13-048400-8. (The first edition is O.K. if you already have it.)

**OPTIONAL TEXTBOOK:** *Switching Power Supply Design*, Second Edition, A.I. Pressman, McGraw-Hill.

**LECTURE NOTES:** Lecture notes are available at the bookstore.

**REQUIRED SOFTWARE:**

**PSpice:** OrCAD PSpice and Capture version 15.2 with RHIT Libraries. OrCAD PSpice is available in the textbook *Schematic Capture With Cadence PSpice*.

**EVALUATION METHODS:** Your final grade will be based on the schedule below:

Homework	20%
Lab	30%
Exam 1	25%
Final Exam	25%

- Your grade will be based on the standard 92%, 82%, 72%, 62% scale.
- Approximate class standings and grade distributions will be distributed after each exam. This distribution is a work of fiction and should only be used as a gross approximation of your performance in the class.
- A grade of incomplete will only be given for circumstances beyond a student's control. Class load, extra curricular activities, and jobs are all circumstances that are under the control of a student and will not justify a grade of incomplete.

## **COURSE POLICIES:**

**HOMEWORK:** There will be 10 homework assignments (order of magnitude estimate). These assignments should be done independently but it never hurts to consult your colleagues. Homework is due at the beginning of class on the due date. Late homework will not be accepted. Solutions are available on [my web site](#). The files are downloadable and can be viewed with the Adobe Acrobat Reader. **You are required to use the standard RHIT format for homework.**

**ATTENDANCE:** Attendance is required.

**LATE HOMEWORK:** Homework is due at the beginning of class on the specified due date. Late homework will not be accepted.

**IN CLASS EXAMS:** These exams are open book, open notes, and open brain (your brain only). Personal computers may only be used during exams to view the class notes. You may not use Maple or PSpice during the exam.

**HONOR CODE:** The honor code will be enforced in this class.

**MAKEUP EXAMS:** Makeup exams will not be given.

**LABORATORY:** You will construct three power supplies. The first lab is an AC to DC converter with a linear regulator. This lab is graded as two labs: the AC to DC converter, and the linear regulator. The second power supply is a 50 W boost regulator that boosts 12 V DC to 25 V DC. This lab is graded as two labs: construction of the power electronics and then the operation of the complete supply. The third power supply is a 50 W buck-boost regulator that converts 12 V to -25 V DC. This lab is graded as three labs: the construction of the power electronics, the gate drive circuit, a local -15 Volt DC power supply, and the complete operation of the entire supply.

Labs are due at a specific time. If you complete the lab on time with the required functionality, you will receive a 100 on the lab. Labs turned in after the specified time are assessed a late penalty of 4% per 24 hour period, excluding weekends.

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**INSTRUCTIONAL PHILOSOPHY:** Topics will be covered in three levels: Theoretical analysis, simulation, and laboratory verification. The following synthesis procedure is used to gain an understanding of circuits covered in the class: The theoretical analysis of the circuit is covered to understand the operation of the circuit or to design a circuit. Circuit simulation using industry standard analysis tools to verify the theoretical analysis or circuit design. If the simulations agree with theoretical analysis, the circuit is constructed in the lab. **Measurements of the circuit performance are made and compared to the theoretical calculations and simulation results.**

## **INSTRUCTIONAL OBJECTIVES**

### **1. Linear DC Supplies**

Half-Wave, Full-Wave, And 3-Phase Rectifier Circuits  
Zener Regulator Circuits  
Pass Transistor Regulators  
OPAMP-Pass Transistor Regulators

### **2. Buck DC-DC Converter Topology**

Circuit Analysis  
Energy Analysis  
Circuit Simulation

Continuous and Discontinuous Modes of Operation  
Capacitor Selection

**3. Boost DC-DC Converter Topology**

Circuit Analysis  
Energy Analysis  
Circuit Simulation  
Continuous and Discontinuous Modes of Operation  
Capacitor Selection

**4. Cuk Converter Topology**

Circuit Analysis  
Energy Analysis  
Circuit Simulation  
Continuous Mode of Operation

**5. Components and Devices**

MOSFETS  
IGBT's  
PWM Control Integrated Circuits  
Diodes  
Inductors  
Capacitors  
Gate Drivers

**6. Charge Pumps**

Inverting Topology  
Voltage Doubling Topology  
Circuit Analysis  
Circuit Simulation

**7. Flyback Converter Topology**

Circuit Analysis  
Energy Analysis  
Circuit Simulation

**8. Transformer Topologies**

Forward  
Half-Bridge  
Full-Bridge  
Push-Pull  
Current-Mode  
Current Fed