ECE 351- Analog Electronics

Winter Quarter 2004-2005

Instructor Information

Instructor:	Tina Hudson
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Phone number:	Office: 872-6028 Home: 877-4394 (between 8am and 8pm only please)
Office number:	D204
Office Hours:	I will be on campus from 11-4:30 M-F. You should be able to find me in my office during these times unless I am in class, lab, or a committee meeting. However, I do like to use 30 minutes before class to prep for class. So please only come by right before class if no other time works for you. If these hours do not work for you, feel free to call me at home between 8am to 8pm or send me email.

Course Information

Meeting Times:	Class: M, T, F 9th hour in O201 Lab: Th 8-10th hour (2:30-5:15) in D115
Prerequisite:	ECE250
Prerequisite Skills:	PSpice simulation Biasing of 3-terminal devices Diode rectifiers Small signal analysis Circuit Analysis Techniques (Nodal Analysis and Superposition)
Text:	Neamen, D.A., *Electronic Circuit Analysis and Design, 2nd Ed.,* McGraw-Hill, 2001. Herniter, M.E. *Schematic Capture With Cadence PSpice, 2nd Ed.,* Prentice Hall, 2003 (first addition is OK if you already have that) Lab Notebook with nonremovable pages and page numbers.
Lab/HW Tools:	**PSpice**: Orcad PSpice and Capture version 9.2 with RHIT Libraries. OrCAD PSpice is available in the textbook *Schematic Capture With Cadence PSpice*. Version 10 of the software is available on the network. The libraries are available for download from Dr. Herniter's website at http://www.rose-hulman.edu/~herniter/Software/Cadence/pspice.htm. Install the OrCAD software first, then install the libraries.

Course Description

This course is intended to provide you with the next level of understanding of analog circuits. ECE250 provided you with an understanding of basic semiconductor device operation (diodes, BJT's, and FET's) and the biasing and analysis of these devices. ECE351 will show you how these devices are used in typical analog circuits, such as power supplies, amplifiers, and comparators. We will explore the d.c. operation and frequency analysis of these circuits. Additionally, the effects of component nonidealities and their effects on analog circuits will also be investigated.

Instructional Philosophy

Analog circuits will be covered on three levels: theoretical analysis, simulation, and laboratory verification. Each of these levels is critical in any circuit design. When presenting the theoretical analysis of a circuit, I will try to help you obtain some intuition about how the circuit operates before launching into a detailed small signal analysis, where intuition is often lost. I hope that you will carry this intuition into future steps of the analysis. Next, we will verify that the theoretical analysis is correct with circuit simulation. Circuit simulation is critical because simple models used for hand calculations cannot encompass all of the nonlinearities and nonidealities associated with even a simple circuit. Simulation will bring to light the impact any of these nonidealities have on the circuit operation. The simulation may show that the circuit may need to be modified to achieve the objectives of the circuit. Once the simulation achieves the objective, the circuit is then constructed in the lab. In theory, the lab circuit should behave identically to the simulation. However, due to tolerances of individual components, some SMALL differences may be measured. However, with the circuits we are exploring, large discrepancies are not expected. In all experiments, measurements of the circuit performance are compared to the theoretical calculations and simulation results.

General Policies

Homework: Homework assignments will be given weekly except on exam weeks. It is due at the BEGINNING of class on the day it is due. Late homework will not be accepted unless prior arrangements have been made. Solutions will be posted on my web site. If solutions have been posted, late homework will not be accepted regardless. The grader must be able to follow your work easily. Your grade is not just a function of knowing the material, but also in being able to communicate it clearly. I don't mind you working with partners on assignments as long as the final work turned in is yours. Direct copying without any thought by you will be evident on exams.

Exams: There will be 2 quarterly exams (4th and 9th week) and 1 final exam that will be cumulative. You must talk with me BEFORE the exam if you have a conflict so that suitable arrangements can be made. Exams missed due to an unexcused absence cannot be made up.

Make-up Exams / Homework: Make-up exams will only be given in the case of a properly excused absence. Late homework will not be graded.

Grading Policy:	Homework:	15%
	Laboratory:	15%

Prelab	5%
Exams:	40% (2 at 20% each)
Final Exam:	25%

Cumulative exam score, including both exams and the final, must be at a passing level (>=60%) in order to pass the course.

All lab work (prelabs and lab notebook for each lab) must be submitted in order to pass the course.

Your grade will be based on the following schedule:

A:	Total Average>=90
B+	90>Total Average>=87
B	87>Total Average>=80
C+	80>Total Average>=77
C	77>Total Average>=70
D+	70>Total Average>=67
D	67>Total Average>=60
F	60>Total Average

Laboratory: Lab grading will be discussed in lab. Please bring the following items to the lab. We will NOT provide these materials for you.

- nickels, dimes, and quarters to purchase parts
- A breadboard. This can be purchased in the lab if you don't already have one.
- Breadboard prototyping wires.
- Hemostats for removing integrated circuits.
- Your lab notebook.
- Glue.
- Scissors.
- A Pen. Pencils are NOT allowed.
- A Floppy disk for printing oscope traces.

ECE351 Outline

1. Small Signal Analysis Review
   - Bias
   - Small Signal Model
   - Gain Calculation
   - Design Example for Specified Gain and Swing
2. Current Sources
   - Current Mirror
   - Widlar Current Source
   - Calculation of Parallel Resistance
3. Amplifier Topologies
   - Differential Amplifiers
   - Push-Pull Amplifiers
4. Cascaded Amplifiers
5. Low Frequency Response
   - Simple RC Circuits
   - Amplifier Low-Frequency Response
   - Low-Frequency Small Signal Model
6. High Frequency Response
   - Simple RC Circuits
   - Miller's Theorem
   - Amplifier High-Frequency Response
7. Operational Amplifier Circuits
   - Review of Feedback
   - Linear Circuits
     - Inverting and Non-inverting
     - Summing and Difference
     - Current to Voltage Converter
     - Integrator and Differentiator
   - Non-Linear Circuits
     - Rectifiers and Limiters
     - Comparators and Schmitt Triggers
   - Non-Ideal Op-Amps
     - Bias Currents
     - Offset Voltage
     - Frequency Response