ECE 484

APPLICATIONS OF ANALOG INTEGRATED CIRCUITS

Spring 2005

COURSE:	M W F	3:00 - 3:50 pm	Room 1225 EB
PREREQ:	ECE 302 & ECE 303		
INSTRUCTOR:	G.M. Wierzba	Room 3215 EB	355-5225; wierzba@msu.edu
WEB SITE:	www.egr.msu.edu/~wierzba		
OFFICE HRS:	M,Tu 4:15 - 5 pm; F 12:30 - 1:30 pm		or by appointment

TEXTS:

G.M. Wierzba, *ECE 484 Course e-Notes, Spring 2005 Edition,* available at Engineering Copy Center (1277 Anthony).

Schubert & Kim, *Active and Non-Linear Electronics*, Wiley, 2004

M. Rashid, *Intro. To PSpice Using Orcad for Circuits and Electronics*, Pearson Prentice Hall, 2004

GRADING:

Three one-hour exams	(2/7, 2/28, 4/11)	200 pts
Final exam*	(Wed. May 4, 3:00 - 5:00 pm)	200 pts
Homework *	(normalized)	50 pts
Lab Grade*		150 pts

*You must obtain a passing grade to pass the course.

POLICIES:

Article 2.3.3 of the Academic Freedom Report states that ***the student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards.*** In addition, the Department of Electrical and Computer Engineering adheres to the policies on academic honesty as specified in General Student Regulations 1.0, Protection of Scholarship and Grades, and in the all-University Policy on Integrity of Scholarship and Grades, which are included in Spartan Life; Student Handbook and Resource Guide.

HOMEWORK:

Homework is to be done on 8.5" x 11" paper using only one side. It must be stapled and ragged edges must be trimmed. Whenever possible, the correct answer is to be circled or boxed. You may work with other students (list all names below yours) but the work you submit must be done by you. Assignments which are identical will all receive a grade of **zero**. You must type and run all of your own computer work. Copying of old assignments or computer files will be dealt with severely.

OTHER:

Only simple scientific calculators are allowed for exams. Exam questions have little or no partial credit. There are NO MAKE UP EXAMS. One 1-hour exam will be dropped in computing your grade. Late homework WILL NOT be accepted. Your lowest homework grade will be dropped in computing your normalized homework grade.

An 85% attendance rate is required to pass the course, that is, you can miss 7 classes. Please keep your own record of absences.

DETAILED TOPICS:

Chapter 1: Operational Amplifiers and Applications

1.1 Basic Amplifier Characteristics

Ideal and Commercial Op-Amps.

1.2 Modeling the Op-Amp

Inverting Amplifier, Zero Volt - Zero Current Property, Inverting Amplifier-Revisted, Modeling an Inverting Amplifier, Application: Stereo Pan-Pot Circuit, Application: Microphone Mixer

Chapter 9: Active Filters

9.1 Bode Plots

Audio Frequency Inverting Amplifier, Product of Terms, Decibel, First-Order Inspections Forms, Making Log Paper and Reading Points, Factoring Equations into Inspection Forms, One Capacitor Approximations, Audio Frequency Inverting Amplifier - Revisted, National Association of Broadcasters Cassette Tape Preamplifier, Treble Tone Control Design, Bass Tone Control Design, Shelving Equalizer

9.2 Filter Characteristics

Second-Order Inspection Forms, Low-Pass, High-Pass, Band-Pass, Band-Stop, Low-Pass Notch, High-Pass Notch, Multiple Feedback Active Filter Design, Ten-Band Octave Room Equalizer, Notch-Filter Design, Symbolic SPICE

9.3 Butterworth Filters

Butterworth Approximation to an Ideal Low-Pass Filter, Butterworth Polynomials, Second Order Low-Pass Building Block, Normalized Response, Magnitude and Frequency Scaling, Third Order Low-Pass Building Block, Nth Order Low-Pass Synthesis, Normalized Low-Pass Design Table, Butterworth High-Pass Approximation, Low-Pass to High-Pass Transformation, Butterworth Band-Pass Filter, Butterworth Band-Stop Filter, Passive Butterworth Low-Pass Filters with Termination

9.8 Op-Amp Limitations

Voltage Gain and Phase Shift, Gain-Bandwidth-Product, Approximations for Dominant Pole and Non-Dominant Pole Op-Amps, Stability, Phase Margin, Rate of Closure, Stabilization Networks, Step Response Due to Bandwidth Limiting, Step Response Due to Slew Rate Limiting, Output Swing, Short Circuit Current, Offset Voltages, Offset Adjustment, Input Bias and Input Offset Currents, Offset Minimization, Macromodeling, Model Testing and Validation

Chapter 13: Waveform Generation and Waveshaping

13.1 Multivibrators

Comparators, Open-collector Comparators, Noninverting Crossing Detector, Inverting Crossing Detector, Inverting Schmitt Trigger, Relaxation Oscillator

13.X Comparator Macromodel

SPICE Macromodel for a Comparator, Comparator Limitations, Voltage Gain, Output Current Sink, Saturation Voltage, Response Time, Input Overdrive, Model Testing and Validation

13.4 Integrated Circuit Multivibrators

555 Functional Block Diagram, Monostable Multivibrator, Astable Multivibrator

13.Y 555 Timer SPICE Model

Transistor Level 555 Timer Model, Timer Limitations, Threshold Voltage and Current, Trigger Voltage and Current, Reset Voltage and Current, Discharge Transistor Specifications, Output Specifications, Supply Current, Model Testing and Validation

13.Z Timer Applications

Capacitance Meter Using a DC Voltmeter, Delay Wipers

Chapter 10: Frequency Response of Transistor Amplifiers

10.X Departure from Ideal Diode Performance

Depletion Capacitance, Diffusion Capacitance, Diode Switching Circuits, SPICE Parameters of a Diode, AC Model of a Diode, SPICE Testing of V-I Characteristics, Reverse Recovery

10.Y Departure from Ideal Transistor Performance

SPICE Parameters of a BJT, AC Model of a BJT, SPICE Testing of V-I Characteristics, Switching Response, Speedup Capacitor, AC Model for a BJT (Giacoletto Model)

10.6 High-Frequency Amplifiers

Wideband Common-Emitter Amplifier, SPICE Evaluation, Short Circuit Time Constants, Open Circuit Time Constants, Loading Effects on Bandwidth

Chapter 14: Power Circuits

14.2 Switching Regulators and DC-DC Converters

Step-Down Regulator (Buck Converter), Efficiency, Ripple, SPICE Simulation of a Step-Down Regulator, Inverting Regulator (Buck-Boost Converter), Efficiency, Ripple, SPICE Simulation of an Inverting Regulator, Step-Up Regulator (Boost Converter), Efficiency, Ripple