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

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 - Revisited, National Association of Broadcasters Cassette Tape Preampier, Treble Tone Control Design, Bass Tone Control Design, Shelving Equalizer

9.2 Filter Characteristics

9.3 Butterworth Filters

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
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 (Giacolotto Model)

10.6 High-Frequency Amplifiers

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