

ECE 200

ELECTRIC CIRCUITS

Summer 2003

COURSE:	M T W T	10:25 - 12:15	Room 1300EB
CO-REQ:	Math 235		
INSTRUCTOR:	G.M. Wierzba	Room 3215EB	355-5225; wierzba@msu.edu
WEB SITE:	www.egr.msu.edu/~wierzba		
OFFICE HRS:	M T W T	1:00 - 1:50 or by appointment	
TEXTS:	G.M. Wierzba, <i>ECE 200 Course e-Notes, Summer 2003 Edition</i> , available on CD at Anthony Hall Copy Center (Room 1277). Thomas & Rosa, <i>The Analysis and Design of Linear Circuits</i> , Prentice-Hall, 2001 (3rd or 4th Edition)		
GRADING:	Three one-hour exams (7/10, 7/24, 8/7)		200 pts
	Final exam (Th 8/14 @ 10:25 - 12:15)*		200 pts
	Homework (normalized)*		50 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 4.5 classes. Please keep your own record of absences.

DETAILED TOPICS:

- Chapter 1: Introduction
 - 1.1 About This Book
 - 1.2 Symbols and Units
 - Prefixes, Engineering Notation
 - 1.3 Circuit Variables
 - Current, Voltage, Power, Passive Sign Convention, Ground, Conservation of Energy, Conservation of Power
- Chapter 2: Basic Circuit Analysis
 - 2.1 Element Constraints
 - Electrical Network, Circuit, Resistance, Ohm's Law, V-I Characteristics, Conductance, Power, Resistor, Color Code, Precision Resistors, Ratings, Open and Short Circuits, Switches, Independent Voltage Sources, Independent Current Sources
 - 2.2 Connection Constraints
 - Kirchhoff's Current Law, Kirchhoff's Voltage Law
 - 2.3 Combined Constraints
 - Assigning Reference Marks
 - 2.4 Equivalent Circuits
 - Series Resistance, Parallel Resistance, Special Cases, Approximations, Equivalent Voltage Sources, Equivalent Current Sources, Source Transformations, Delta-to-Wye and Wye-to-Delta Transformations, Redundant Elements
 - 2.5 Voltage and Current Division
 - Voltage Divider Rule, Special Cases, Potentiometers, Current Divider Rule, Special Cases, Meter Movements, Wheatstone Bridge
- Chapter 3: Circuit Analysis Techniques
 - 3.1 Node-Voltage Analysis
 - Element Inspection Rule, Writing Node Equations by Inspection, Cramer's Rule, Evaluating Determinants, Node Analysis with Voltage Sources, Supernode
 - 3.2 Mesh-Current Analysis
 - Element Inspection Rule, Writing Mesh Equations by Inspection, Mesh Analysis with Current Sources, Supermesh
 - 3.3 Linearity Properties
 - Superposition Principle, Proportionality Property, Transfer Function, Unit Output Method
 - 3.4 Thevenin and Norton Equivalent Circuits
 - Thevenin's Theorem, Norton's Theorem, Relationships
 - 3.5 Maximum Signal Transfer
 - Second Derivative Test, Maximum Power Transfer Theorem, Maximum Efficiency Theorem, Computer-Aided Circuit Analysis, SPICE, MATLAB
- Chapter 4: Active Circuits
 - 4.1 Linear Dependent Sources
 - Voltage Controlled Sources, Current Controlled Sources, SPICE Models
 - 4.2 Analysis of Circuits with Dependent Sources
 - Node-Voltage Analysis, Mesh-Current Analysis, Thevenin and Norton Equivalent Circuits

4.4	The Operational Amplifier	Notation, Ideal and Commercial Op-Amps, Non-inverting Amplifier, Zero Volt - Zero Current Property, Modeling a Non-inverting Amplifier, Limitations Due to the Power Supply, Voltage Follower, Inverting Amplifier and Model, Differential Amplifier and Model, Op-Amp Circuit Analysis, Bridge-T Amplifier
Chapter 6:	Capacitance and Inductance	
6.1	The Capacitor	V-I Relationship of Capacitance, Plotting Power and Energy with SPICE, Capacitor, Modeling a Capacitor with Ideal Elements
6.2	The Inductor	V-I Relationship of Inductance, Plotting Power and Energy with SPICE, Inductor, Modeling an Inductor with Ideal Elements
6.4	Equivalent Capacitance and Inductance	Series and Parallel Combinations of Capacitance, Series and Parallel Combinations of Inductance
Chapter 7:	First-Order Circuits	
7.2	First-Order Circuit Step Response	Step Response of an RC Circuit, Algorithm for any One Capacitance Circuit, Time Constant, Interpretation of the Time Constant, Step Response of an RL Circuit, Algorithm for any One Inductance Circuit, Time Constant, Sequential Switching, Algorithm for Sequential Switching, PSpice Simulation with Switches
7.4	First-Order Circuit Sinusoidal Response	Natural and Forced Response, RC Circuits
Chapter 8:	Sinusoidal Steady-State Response	
5.4	The Sinusoidal Waveform	Cycle, Period, Frequency, Amplitude, Phase Angle
8.1	Sinusoids and Phasors	Vector Representation of Sinusoids, Euler's Formula, Complex Numbers, Rectangular and Polar Form, Phasor Transform, Inverse Phasor Transform, Addition- Subtraction- Multiplication-Division of Complex Numbers
8.2	Phasor Circuit Analysis	Kirchhoff's Current Law, Kirchhoff's Voltage Law, Resistance in Phasor Form, Capacitance in Phasor Form, Inductance in Phasor Form, Impedance, Admittance
8.3	Basic Circuit Analysis with Phasors	Series Equivalence of Impedances, Reactance, Phasor Analysis Algorithm, Voltage Divider Rule, Parallel Equivalence of Impedances, Susceptance, Current Divider Rule, SPICE, Resonant Frequency of an Impedance, Series Resonance, Parallel Resonance
8.4	Circuit Theorems with Phasors	Superposition, Source Transformations, Thevenin and Norton Equivalent Circuits
8.5	General Circuit Analysis with Phasors	Node-Voltage Method, MATLAB, Mesh-Current Method
8.6	Energy and Power	Root-Mean-Square

Chapter 12: Frequency Response

12.6 Bode Plots

Product of Terms, Decibel, First-Order Inspections Forms, Making Log Paper and Reading Points, Factoring Equations into Inspection Forms, Second-Order Inspection Forms, RLC Low-Pass Filter, RLC High-Pass Filter, RLC Band-Pass Filter, RLC Band-Stop Filter

Chapter 15: Mutual Inductance

15.1 Coupled Inductors

Magnetic Flux, V-I Characteristics

15.2 The Dot Convention

Examples of Coupled Coils

15.3 Energy Analysis

Coupling Coefficient

15.4 The Ideal Transformer

Perfect Coupling, Equivalent Input Resistance

Chapter 16: Power in Sinusoidal Steady-State

16.1 Average and Reactive Power

16.2 Complex Power

Apparent Power, Power Factor, Reactive Power Factor, Power Factor Angle, Power Triangle, Complex Power and Load Impedance

16.3 AC Power Analysis

Conservation of Complex Power Theorem, Power in Purely Resistive Circuits, Power in Purely Capacitive Circuits, Power in Purely Inductive Circuits

16.4 Load-Flow Analysis

Power Factor Correction, Step-up and Step-Down Transformers, Residential Service, Wiring and Grounding, Electrical Safety, Grounding Appliances and Power Tools, Ground-Fault Circuit Interrupter

16.5 Three-Phase Circuits

Wye-Connected Source, Wye and Delta Loads

16.6 Three-Phase AC Power Analysis

Wye-Connected Source and Load, Instantaneous Power

Chapter 7: Second-Order Circuits

7.5 The Series RLC Circuit

Natural Response, Characteristic Equation, Overdamped, Critically Damped and Underdamped Response, SPICE

7.6 The Parallel RLC Circuit

Natural Response, Characteristic Equation, Overdamped, Critically Damped and Underdamped Response, SPICE

7.x Complete Response

Series RLC with a Switched Sinusoidal Input, PSpice