

ECE 345

ELECTRONIC INSTRUMENTATION AND SYSTEMS

Summer 2003

COURSE:	T Th	9:05 - 9:55 am	Room 2243 EB
PREREQ:	MTH 235 (or LBS 119) and PHY 184		
INSTRUCTOR:	G.M. Wierzba	Room 3215 EB	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 345 Course e-Notes, Summer 2003 Edition</i> , available on CD at Anthony Hall Copy Center (Room 1277). Rizzoni, <i>Principles and Applications of Electrical Engineering</i> , McGraw - Hill, 2003, 4th Edition		
GRADING:	Three one-hour exams (6/3 7/1, 7/29)		200 pts
(2/3)	Final exam (Th 8/14 @ 9:10 - 10:00)*		200 pts
	Homework (normalized)*		50 pts

**You must obtain a passing grade to pass the course.
You must also pass the lab 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**. Copying of old assignments 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 5 classes. Please keep your own record of absences.

DETAILED TOPICS:

- Chapter 1: Introduction to Electrical Engineering
 - 1.3 Fundamentals of Engineering Exam Review
 - 1.4 Brief History of Electrical Engineering
 - 1.5 System of Units
 - Prefixes, Engineering Notation

- Chapter 2: Fundamentals of Electric Circuits
 - 2.2 Charge, Current, and Kirchhoff's Current Law
 - Charge, Current, Nodes, Conservation of Charge, Kirchhoff's Current Law, Interpretation of Signs
 - 2.3 Voltage and Kirchhoff's Voltage Law
 - Voltage, Closed Path, Conservation of Energy, Kirchhoff's Voltage Law, Interpretation of Signs
 - 2.1 Ideal Voltage and Current Sources
 - Ideal Voltage Source, V - I Characteristics, Ideal Current Source, V - I Characteristics
 - 2.4 Electric Power and Sign Convention
 - Power, Energy, Passive Sign Convention
 - 2.6 Resistance and Ohm's Law
 - Ohm's Law, Conductance, Power, Resistor, Open Circuit, Short Circuit, Series Resistances, Voltage Divider, Parallel Resistances, Current Divider
 - 2.8 Measuring Devices
 - Ohmmeter, Ammeter, Voltmeter, Wheatstone Bridge

- Chapter 9: Semiconductors and Diodes
 - 9.3 Circuit Models for the Semiconductor Diode
 - V - I Characteristics, Piecewise Linear Model, Transition Point, Assumed States for Analysis, Strategy for Guessing States
 - 9.2 The Semiconductor Diode
 - Non-Ideal Diode, V - I Characteristics, Piecewise Linear Model, Light-Emitting-Diodes
 - 9.5 Zener Diode
 - Piecewise Linear Model, Shunt Regulator

- Chapter 8/15: Operational Amplifiers and Comparators
 - 8.2 The Operational Amplifier (Op-Amp)
 - Ideal Op-Amp, $0V$ - $0A$ Property, Inverting Amplifier, Power Supply Limitations, Non-Inverting Amplifier
 - 15.5 Comparator
 - Ideal Comparator, Inverting Crossing Detector, Non-Inverting Crossing Detector

- Chapter 3: Resistive Network Analysis
 - 3.2 The Node-Voltage Method
 - Node-Voltage Inspection Property, Node-Voltage Analysis with Current Sources, Cramer's Rule, Node-Voltage Analysis with Voltage Sources

- 3.3 The Mesh-Current Method
 - Planar Circuits, Mesh-Current Inspection Property, Mesh-Current Analysis with Voltage Sources, MATLAB, Mesh-Current Analysis with Current Sources
- 3.5 The Principle of Superposition
 - Superposition, Zero Sources, Proportionality, Linearity
- 3.6 One Port Networks and Equivalent Circuits
 - Thevenin's Theorem, Norton's Theorem, Source Transformations
- 3.4 Dependent Sources
 - Dependent Voltage Sources, Dependent Current Sources, Node-Voltage Analysis with Dependent Sources, Mesh-Current Analysis with Dependent Sources, Op-Amp, Inverting Amplifier - Revisited, Modeling with Dependent Sources, Stereo Pan-Pot / Fader Circuit, Thevenin and Norton Equivalent Circuits with Dependent Sources

- Chapter 10: Transistor Fundamental
 - 10.2 The Bipolar Junction Transistor (BJT)
 - NPN, Active Region, Saturation Region, Cut-Off Region, Edge-of-Saturation, Edge-of-Cut-Off, PNP, Active Region, Saturation Region, Cut-Off Region, Edge-of-Saturation, Edge-of-Cut-Off

- Chapter 5: Transient Analysis
 - 4.1 Energy-Storage Circuit Elements
 - Capacitance, V - I Characteristics, Power and Energy, Capacitor, Insulation Resistance, Parallel Capacitance, Series Capacitance, Inductance, V - I Characteristics, Power and Energy, Inductor, Equivalent Series Resistance, Series Inductance, Parallel Inductance
 - 5.4 Transient Response of First-Order Circuits
 - Step Response of an RC Circuit, RC Circuit Algorithm, Significance of the Time Constant, Step Response of an RL Circuit, RL Circuit Algorithm, Natural and Forced Response, Transient Response with an AC Source

- Chapter 4: AC Network Analysis
 - 4.2 Time-Dependent Signal Sources
 - Sinusoids, Cycle, Period, Frequency, Phase Angle, Amplitude, Average and RMS Values
 - 4.4 Phasors and Impedance
 - Vector Representation of Sinusoids, Phasors, Euler's Identity, Complex Numbers, Rectangular Form, Polar Form, Phasor Transform, Inverse Phasor Transform, Complex Algebra, Kirchhoff's Voltage Law with Phasors, Kirchhoff's Current Law with Phasors, Ohm's Law in the Frequency Domain, Impedance, Admittance
 - 4.5 AC Circuit Analysis Methods
 - Series Impedances, Phasor Analysis Algorithm, Series Resonance

- Chapter 6: Frequency Response and Systems Concepts
 - 6.1 Sinusoidal Frequency Response
 - Fourier Series
 - 6.3 Filters
 - Low-Pass Filter, Bode Plots, High-Pass Filter, Band-Pass Filter, Band-Stop (Notch) Filter