

# ECE 202

## ELECTRIC CIRCUITS AND SYSTEMS II

Summer 2009

---

<b>COURSE:</b>	M W F	12:40 pm - 2:30 pm	Room 1257 AH
<b>PRE-REQ:</b>	ECE 201		
<b>CO-REQ:</b>	MTH 235 and ECE 203		
<b>INSTRUCTOR:</b>	G.M. Wierzba	Room 3215 EB	355-5225; wierzba@msu.edu
<b>WEB SITE:</b>	www.egr.msu.edu/~wierzba		
<b>OFFICE HRS:</b>	M W F	11:30 - 12:00 or by appointment	
<b>TEXTS:</b>	G.M. Wierzba, <i>ECE 202 Course e-Notes, Summer 2009 Edition</i> , available at <a href="http://stores.lulu.com/willowepublishing">http://stores.lulu.com/willowepublishing</a>		
	Thomas & Rosa, <i>The Analysis and Design of Linear Circuits</i> , Wiley, 2009 (6th Edition)		
<b>GRADING:</b>	Three one-hour exams (7/17, 7/31, 8/14)		200 pts
	Final exam (W 8/19 @ 12:40 - 2:30)*		200 pts
	Homework (normalized)*		50 pts
	<i>*You must obtain a passing grade to pass the course.</i>		
<b>POLICIES:</b>	You are expected to arrive for class on time. No laptop computers are allowed during class. No student can wear earphones during class.		
<b>HOMEWORK:</b>	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 <b>zero</b> . You must type and run all of your own computer work. Copying of old assignments or computer files will be dealt with severely.		
<b>OTHER:</b>	Only simple scientific calculators are allowed for exams. Exam questions have little or no partial credit. There are <b>NO MAKE UP EXAMS</b> . One 1-hour exam will be dropped in computing your grade. Late homework <b>WILL NOT</b> 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 3.5 classes. Please keep your own record of absences.***

## DETAILED TOPICS:

- 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  
Average Power for a Resistance, Inductance and Capacitance, Root-Mean-Square
- Chapter 9: Laplace Transforms
- 9.1 Signal Waveforms and Transforms  
Definition of the Laplace Transformation, Step Function, Impulse Function, Inverse Transformation, Uniqueness Property
  - 9.2 Basic Properties and Pairs  
Linearity, Integration Property, Ramp Function, Differentiation Property, Nth Derivative, S-Domain Translation Property, Time Domain, Translation Property, Table of Transform Pairs
  - 9.3 Pole-Zero Diagrams  
Definition of pole and zero, Sketches, MATLAB
  - 9.4 Inverse Laplace Transforms  
Rational Function, Partial Fraction Expansion, Residues, Complex Poles, Sum of Residues
  - 9.5 Some Special Cases  
Improper Rational Function, Multiple Poles, MATLAB
- Chapter 10: S-Domain Circuit Analysis
- 10.1 Transformed Circuits  
Element Constraints in the S-Domain, Sources, Connection Constraints, Examples of the Complete Response of RC and RL switching circuits
  - 10.2 Basic Circuit Analysis in the S-Domain  
Phasors revisited

- 10.3 Circuit Theorems in the S-Domain  
Proportionality, Superposition, Norton Equivalent Circuits
- 10.4 Node-Voltage Analysis in the S-Domain  
S-Domain Node Equations by Inspection
- 10.5 Mesh-Current Analysis in the S-Domain  
S-Domain Mesh Equations by Inspection
  
- Chapter 11: Network Functions
  - 11.1 Definition of a Network Function  
Natural and Forced Response, Stability
  - 11.2 Network Functions of One- and Two-Port Circuits  
Driving Point Impedance, Transfer Functions
  - 11.3 Network Functions and Impulse Response  
Definition, Pspice Example of an Impulse Response
  - 11.4 Network Functions and the Step Response  
Definition
  - 11.6 Impulse Response and Convolution  
Definition of Convolution, Causal and Non-Causal Signals, Equivalence of S-Domain and t-Domain Convolution, Graphical Approach
  - 11.7 Network Function Design  
Synthesis, First Foster RC Forms, NAB Equalizer Design, Magnitude Scaling
  
- Chapter 12: Frequency Response
  - 12.1 Frequency Response Descriptors  
Types of Filters, Pass Bands, Stop Bands
  - 12.5 Bode Diagrams  
Product of Terms, Decibel, First-Order Inspections Forms, Making Log Paper and Reading Points
  - 12.2 First Order Circuit Frequency Response  
Audio Frequency Inverting Amplifier, Interpretations of Poles and Zeros, RIAA Playback Equalizer, First-Order High-Pass Response, Audio Frequency Intergrator, First-Order Low-Pass Response, Low-Noise Inverting Amplifier, Band-Pass Using First-Order Circuits
  - 12.3 Second-Order Circuit Frequency Response  
Second-Order Inspection Forms, RLC Low-Pass Filter, Hiss Filter, RLC High-Pass Filter, RLC Band-Pass Filter, RLC Band-Stop Filter, Design Procedure, Bandwidth, Data Recorder Filter Design
  
- Chapter 13: Fourier Series
  - 13.2 Fourier Coefficients  
Fourier Series, Sawtooth Example, Fundamental Frequency, Harmonics, Alternative Form of the Fourier Series
  - 13.3 Waveform Synthesis  
Even Symmetry, Odd Symmetry, Half-Wave Symmetry

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
- 15.5 Transformers in Sinusoidal Steady-State  
Model

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, Maximum Real Power Transfer Theorem
- 16.5 Three-Phase Circuits  
Three-Phase Voltage Sources, Phase Sequence, Line / Phase Relationships
- 16.6 Three-Phase AC Power Analysis  
Y-Connected Source and Y-Connected Load, Y-Connected Source and  $\Delta$ -Connected Load