ECE 202-001: Circuits and Systems II

Fall 2019

Instructor:	Bingsen Wang	Classroom:	EB 1145
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Prerequisite

(ECE 201) and ((MTH 235 or concurrently) or MTH 340 or MTH 347H)

Textbook

Thomas, Rosa & Toussaint, The Analysis and Design of Linear Circuits, Wiley, 2016 (8th Edition)

Supplemental Textbook and Online Lectures

- G.M. Wierzba, ECE202 Course e-Notes, Fall2019 Edition, available free at https://www.egr.msu.edu/~wierzba/ECE202_Fall_2019.pdf. You need to download this ebook by Nov. 25, 2019. After that time it will be removed and will no longer be available.
- G.M. Wierzba, Online lectures at https://www.youtube.com/user/202msu

Course Description

Sinusoidal steady-state response. Laplace transforms. S-Domain circuit analysis. Frequency response. Fourier series. Mutual inductance. Power in sinusoidal steady state.

Course Objectives

At the completion of this course, each student should be able to do the following:

1. Analyze AC circuits in steady-state using phasors.
2. Understand the properties of the Laplace transform.
3. Analyze circuits using a Laplace transform.
4. Understand the properties of convolution.

5. Sketch Bode plots.
6. Understand the meaning of filtering.
7. Understand the properties of the Fourier Series.
8. Analyze circuits with mutual inductance.
9. Calculate power in sinusoidal steady-state.
10. Use SPICE simulation and MATLAB to predict the response of linear circuits.

Grading

- Points are distributed as follows:

Class Participation (12%):	Attendance and engagement
Homework (18%):	Homework problem sets will be distributed.
Midterm Exams 1,2,3 (45%):	Each midterm exam will be counted as 15%
Final Exam (25%):	Final exam will be comprehensive.

- A numerical grade will be given based on the total combined score that is normalized to 100 points.

4.0: $\geq$90	3.5: $\geq$85, $<$90	3.0: $\geq$80, $<$85
2.5: $\geq$75, $<$80	2.0: $\geq$70, $<$75	1.5: $\geq$65, $<$70
1.0: $\geq$60, $<$65	0.0: $<$60	

Attendance Policy

Classroom attendance is expected and required. Attendance may be checked at any point of class period. If you arrive at the class after attendance has been checked, or you leave the class after the attendance has been checked, you will be recorded as missing one class. The attendance can be checked in any form the instructor may choose. It is the students responsibility to obtain notes for any missed classes. Some of the lecture notes will be uploaded to D2L wile some may not be. I strongly encourage you to attend each and every class because not all the in-class discussions will be captured by the lecture notes. The past experience indicated a strong correlation between the class attendance and the final grade.

Your are allowed to miss three (3) classes without excuse. No excused absence will be considered unless the number of excused absences exceed three (3).

Homework Policy

Homework will be due one week after it is assigned. Homework is due at the **<u>start of class</u>**. Points will be deducted for late homework as follows:

- Homework received 15 minutes after the start of class: 10 points deducted
- Homework received after the end of class: 30 points deducted

- Homework received one hour or more after class: homework not accepted (score of zero entered)

Your lowest homework grade will be dropped in computing your homework grade. It is important to note that **you must obtain a passing grade (60%) in Homework to pass the course**.

Exam Policy

You must obtain a passing grade (60%) in Final Exam to pass the course.

Makeup exam is only considered for the midterm exams under following situations: (see https://ombud.msu.edu/classroom-policies/index.html#attend-general)

- Grief absence;
- Medical excuse;

Students who do not take the final exam will receive a score of 0.0 in the class. Students who request a rescheduled ECE 202 Final Exam based on the MSU "3-exam in 1 day policy" must request rescheduling by sending an email to the instructor. The request must be made prior to the last regularly scheduled class day and approval of the request is based on confirmation of enrollment in the classes having concurrent exams, and consistency of the final exam schedules.

No midterm exam will be dropped in computing your grade.

Calculators Allowed for Exams

Unless stated otherwise, bring a calculator to the exams. You may use any scientific or graphing calculator, unless it has features described on the following "Prohibited" list.

- Pocket organizers;
- Handheld or laptop computers;
- Electronic writing pads or pen-input devices;
- Calculators built into cell phones or other electronic communication devices;
- Calculators with a typewriter keyboard (keys in QWERTY format). Calculators with letter keys not in QWERTY format are permitted.

Exam Schedule

The 50-minute exams are held in the classroom during the regularly scheduled class time. Exams are closed book and notes. There are NO formula sheets or any cheat-sheets allowed for the exams. The exam dates are (Tentative for Exams 1-3. Changes will be informed two weeks before the exams if any):

Exam 1 (Chp 8,9):	Sep. 30, 2019 (Monday), 9:10am - 10:00am in EB 1145
Exam 2 (Chp 10-12):	Oct. 28, 2019 (Monday), 9:10am - 10:00am in EB 1145
Exam 3 (Chp 13,15):	Nov. 18, 2019 (Monday), 9:10am - 10:00am in EB 1145
Final(Chp 8-13,15,16):	Dec. 12, 2019 (Thursday), 7:45am - 9:45am in EB 1145

No Cheating

Cheating will not be tolerated at any level, which applies to homework, exams and any class activities for this course. Any lowest score (including class activity, homework and exam) due to cheating is NOT eligible to be excluded from the final grade calculation. Besides the obvious legal and ethical aspects, cheating lowers the quality of the University degree, angers fellow students, and diminishes the enjoyment of teaching for the instructor. Any instance, even the most minute, will have the heaviest possible repercussions. Please familiarize yourself with the policies regarding academic integrity at https://ombud.msu.edu/academic-integrity/index.html.

Help Room

Location:	TBD
Day and Time:	TBD

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, Eulers Formula, Complex Numbers, Rectangular and Polar Form, Phasor Transform, Inverse Phasor Transform, Addition-Subtraction- Multiplication-Division of Complex Numbers
- 8.2 Phasor Circuit Analysis
  Kirchhoffs Current Law, Kirchhoffs 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, SourceTransformations,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, IntegrationProperty, RampFunction, DifferentiationProperty, 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 Δ-Connected Load