

## ELEG 2114 – ELECTRIC CIRCUITS II

### Credits and Contact Hours

Three credit hours, 45 hours of instructor contact

### Instructor's Name

Roy McCann

### Textbook

Electric Circuits, James W. Nilsson and Susan A. Riedel, 9<sup>th</sup> Ed., Pearson/Prentice Hall, 2011.  
Electric Circuits II Laboratory Manual, University of Arkansas, 2013, Soft Copy.

### Specific Course Information

- a. Catalog description: Introduction to complex numbers. Sinusoidal steady-state analysis of electric circuits, active, reactive, apparent and complex power; balanced and unbalanced three-phase circuits; mutual inductance; the use of the Laplace transform for electric circuit analysis and two-port networks.
- b. Prerequisites or corequisites: Corequisite: Lab component. Pre- or corequisite: Math 2584. Prerequisites: ELEG2104.
- c. Required course for ELEG majors.

### Specific Goals for the Course

#### 1. Specific outcomes of instructions

After completing this course and the associated lab, students should be able to:

1. Solve basic ac electrical circuits comprising independent and dependent voltage and current sources with series and parallel connections of resistors, inductors and capacitors.
2. Become proficient in applying to ac circuits the various analysis techniques using phasors for ohm's law, Kirchhoff's current and voltage laws, superposition, source transformation, node voltage and mesh current analyses, and Thevenin/Norton equivalent circuit techniques.
3. Be able to analyze simple three-phase balanced ac circuits, including the ability to convert between equivalent delta and wye circuit configurations.
4. Analyze and solve electrical circuit problems using Laplace transform, and acquire a basic understanding of transfer function analysis.
5. Gain an introductory familiarity with two-port network analysis and frequency-selective operational amplifier circuits.
6. Be able to simulate simple electrical circuits using PSPICE and Matlab-Simulink.
7. Be able to safely operate laboratory equipment that is required to successfully perform the lab experiments.
8. Become familiar with at an introductory level with the packaging of electrical components and the assembly of electrical circuits onto printed circuit boards.
9. Gain an awareness of ethical engineering practices.
10. Become introduced to requirements and specification based design methods.

#### 2. Indicate the student outcomes listed in Criterion 3 addressed by the course

- (a) Students are required to **apply knowledge of math** (e.g., solving coupled linear equations, complex variables, matrix algebra, and calculus), **science** (e.g., concepts of

- charge, current, voltage, capacitance, energy, inductors, magnetic energy, etc.), **and engineering** (electrical engineering designs) in analyzing circuits.
- (b) Students **conduct laboratory experiments** that confirm the theoretical aspects taught in the lectures and homework assignments. Students also contrast the ideal results of theoretical circuit analysis compared to the uncertainties encountered with physical circuit implementations.
  - (c) Students use PSPICE and Matlab-Simulink tools in analyzing circuits and **designing simple circuits** in homework assignments and prelabs. A computer-based Matlab-Simulink (SimPower Systems) **design project** is included in the last two weeks of the course where more detailed component models (e.g., equivalent series resistance and inductance of capacitor devices) are included from commercially available **components**.
  - (e) Students are required to **solve electrical engineering problems** as they learn to use circuit analysis tools and learn to use equipment and devices safely in the lab.
  - (g) Student laboratory reports are graded in part based upon the clarity and correctness in order to further develop their written **communication** skills.
  - (j) Students are made aware of some **contemporary issues** relating to **sustainable electrical power generation through an essay assignment that involves a brief search of library resources**.
  - (k) Students learn **PSPICE** and Matlab-Simulink as **engineering tools** besides learning various analysis techniques for designing systems and subsystems.

#### **List of Topics Covered in Class (class time: 75 minutes, 30 class meetings)**

1. Review of complex numbers and introduction to sinusoidal sources (1 class)
2. Frequency domain representation of passive electrical circuit elements and the phasor transformation (1 class).
3. Analysis using phasors based on Kirchoff's laws, Thevenin/Norton equivalents, nodal and mesh analysis for series/parallel circuits (4 classes).
4. Real and reactive power calculations, power factor, power factor correction and maximum power transfer relationships (5 classes).
5. Balanced three-phase sources, three-phase circuits, wye-delta transformations, power calculations in balanced three-phase circuits (5 class periods).
6. Laplace transforms and applications to solving electrical circuits (3 class periods).
7. Use of  $s$ -domain representation of RLC circuits, impulse response and transfer function approach to circuit analysis (4 classes).
8. Two-port network terminal equations and parameters (two classes).
9. Project for dc-dc converter and computer based design methods (three classes).
10. Mid-term exams (two class periods).

#### **List of Labs (Lab time: 170 min.)**

1. Laboratory 1: Frequency and Phase Shift Measurements
2. Laboratory 2: Series, Parallel, and Series-Parallel AC Circuits
3. Laboratory 3: Mesh and Nodal Analysis of AC Circuits
4. Laboratory 4: Thévenin's Theorem for AC Circuits
5. Laboratory 5: Power Measurement and Maximum Power Transfer
6. Laboratory 6: Circuit board and soldering project (dc-dc converter)