ECE Course Outline

ECE 2040 – Circuit Analysis (3-0-3)

Prerequisites: PHYS 2212[C] /2232[C] and MATH 2403[C]*/2413[C]*/24X3[C]*

Corequisites: None

Catalog Description: Basic concepts of DC and AC circuit theory and analysis.

Textbook(s):

Course Objectives – As part of this course, students:
1. understand basic concepts of DC and AC circuit behavior.
2. develop and solve mathematical representations for simple RLC circuits.
3. understand the use of circuit analysis theorems and methods.
4. use basic experimental equipment to measure voltage waveforms.

Course Outcomes – Upon successful completion of this course, students should be able to:
1. analyze small RLC circuits by hand.
2. use network techniques, like node analysis and loop analysis, to write equations for large linear circuits.
3. apply Thevenin and Norton theorems to analyze and design for maximum power transfer.
4. apply the concept of linearity and the associated technique of superposition to circuits and networks.
5. analyze circuits containing ideal operational amplifiers.
6. measure time constants for first-order circuits.
7. explain the concept of steady state.
8. apply phasor analysis to AC circuits in sinusoidal steady state.
9. analyze the frequency response of circuits containing inductors and capacitors.
10. construct simple Bode plots for first- and second-order circuits.
11. measure frequency responses of circuits.

Topical Outline

1. Basic Concepts
   a. Voltage, Current, Power and Energy
   b. Circuit elements (R, L, C, ideal operational amplifiers, ideal transformer)
   c. Independent and Dependent Sources
   d. Kirchhoff's Laws
2. DC circuit analysis
   a. Node Analysis
   b. Mesh Analysis

3. Network Theorems
   a. Linearity
   b. Superposition
   c. Source Transformations
   d. Thevenin's Theorem
   e. Norton's Theorem

4. Circuits Containing Operational Amplifiers
   a. Ideal Op Amp model, with negative feedback condition
   b. Inverting and Non-Inverting Configurations
   c. Voltage Followers, Adders, Difference Amplifiers

5. First and Second-Order Circuits
   a. Singularity Functions
   b. RC and RL Source-Free Circuits
   c. Constant and Non-Constant Forcing Functions
   d. Initial and Final Values
   e. Op-amp circuits for integration and differentiation
   f. Measurement of signals in physical circuits
   g. RLC circuits
   h. Time-Domain Analysis

6. Sinusoidal Steady-State (SSS) Analysis
   a. Sinusoids
   b. Complex Numbers
   c. Complex Exponential Representations of Sinusoids (Phasors)
   d. Impedance and Admittance
   e. Superposition, Thevenin’s and Norton’s Theorems
   f. Analysis and Network Theorems for SSS
   g. Frequency response
   h. Bode plots
   i. Resonance
   j. Measurement of frequency response of physical circuits

7. Power Analysis
   a. Instantaneous and Average Power
   b. Power Factor and Power Factor correction
   c. Complex Power
   d. Maximum Power Transfer