Course Description

EET3716C | Advanced System Analysis | 4.00 credits

This is an upper division level course for students majoring in electronics engineering technology designed to prepare students to perform electrical circuit systems analysis using Laplace transform and partial fraction expansion. Students will learn theorems, Fourier series, frequency response and bode plots, and their application towards practical systems. Prerequisite: EET 1025C and MAC 2312.

Course Competencies

Competency 1: The student will demonstrate the ability to solve problems related to transient analysis of first-order circuits by:

1. Defining a first-order circuit.
2. Using differential equations to solve for voltage or current changes in a first-order circuit.
3. Determining the natural and step responses of both Resistor-Inductor (RL) and Resistor-Capacitor (RC) circuits.
4. Describing the concepts of forced and natural solutions.
5. Computing and using the time constant in predicting instantaneous values.
6. Computing transient and steady-state solutions and investigating their respective waveforms.
7. Analyzing operational amplifier (op-amp) circuits containing resistors and a single capacitor.

Competency 2: The student will demonstrate the ability to solve problems related to transient analysis of second-order electric circuits by:

1. Defining a second-order circuit.
2. Using differential equations to solve for any voltage or current in a second-order circuit.
3. Determining the natural and step responses of both Resistor-Inductor (RL) and Resistor-Capacitor (RC) circuits.
4. Defining second-order differential equations.
5. Analyzing RLC circuits.
6. Computing the natural frequency and the damping ratio.
7. Discussing critical damping.

Competency 3: The student will demonstrate the ability to solve problems related to steady-state analysis of first and second-order electric circuits by:

1. Performing phasor transform and inverse-phasor transforms.
2. Transforming a circuit with a sinusoidal source into the frequency domain using phasor concepts.
3. Using circuit analysis techniques to solve a circuit in the frequency domain.
4. Analyzing circuits containing linear transformers using phasor methods.
5. Describing the ideal transformer constraints and analyzing circuits containing ideal transformers using phasor methods.
6. Describing the following alternating current (AC) power concepts, their relationships to one another, and how to calculate them in a circuit: instantaneous power, average (real) power, reactive power, complex power, and power factor.
7. Describing the condition for maximum real power delivered to a load in an AC circuit.
8. Calculating the load impedance required to deliver maximum real power to the load.
9. Calculating all forms of AC power in AC circuits with linear transformers and in AC circuits with ideal transformers.

Competency 4: The student will demonstrate an understanding of circuit analysis using Laplace Transforms by:

1. Solving a differential equation.
2. Deriving the complex impedance for a capacitor.

3. Finding the transfer function from the impulse response.
4. Using the method of partial fraction expansion.
5. Mixing sines, cosines, and exponentials to solve equations.
6. Computing phase delay.

Competency 5: The student will demonstrate the ability to apply the transfer function by:

1. Using the transfer function to analyze single-input single-output electronic filters.
2. Applying the transfer function to signal processing, communication theory, and control theory.
3. Defining linear time-invariant (LTI) systems.
4. Identifying the important characteristics of LTI systems.
5. Designing and modeling simple LTI systems and computing their transfer function in order to compare theoretical vs. practical systems.

Competency 6: The student will demonstrate the ability to perform frequency response analysis and bode plots by:

1. Using Nyquist stability criterion to predict the stability and performance of a closed-loop system.
2. Computing gain margin.
3. Computing phase margin.
4. Drawing and interpreting Bode magnitude plots and Bode phase plots.
5. Expressing power ratios in decibels and decibels in power ratios.
6. Predicting gain and phase margin.
7. Calculating bandwidth frequency.
8. Analyzing closed loop response.

Competency 7: The student will demonstrate an understanding of balanced three-phase circuits by:

1. Analyzing a balanced, three-phase wye-wye connected circuit.
2. Analyzing a balanced, three-phase wye-delta connected circuit.
3. Calculating power (average, reactive, and complex) in any three-phase circuit.

Competency 8: The student will demonstrate the ability to analyze and design frequency selective circuits and active filters by:

1. Describing the RL, RC, and RLC (Resistor-Inductor-Capacitor) circuit configurations that act as low- pass, high-pass, and band-pass filters.
2. Defining RL, RC, and RLC circuit component values to meet a specified cutoff frequency for low-pass, high-pass, and band-pass filters.
3. Describing the relationship among the center frequency, cutoff frequencies, bandwidth, and quality factor of a band pass and band reject filter.
4. Selecting appropriate RLC circuit component values to meet design specifications.
5. Describing the op-amp circuits that behave as first-order low-pass and high-pass filters.
6. Calculating component values for these circuits to meet specifications of cutoff frequency and pass band gain.
7. Designing filter circuits starting with a prototype circuit and using scaling to achieve desired frequency response characteristics and component values.
8. Using cascaded first- and second-order Butterworth filters to implement low-pass, high-pass, band pass, and band reject filters of any order.
9. Using design equations to calculate component values for prototype narrowband, band pass, and band reject filters to meet desired filter specifications.

<u>**Learning Outcomes:**</u>

- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning