ENGR G285: ENGINEERING CIRCUITS

Item	Value
Curriculum Committee Approval Date	09/17/2019
Top Code	090100 - Engineering, General (requires Calculus) (Transfer)
Units	4 Total Units
Hours	108 Total Hours (Lecture Hours 54; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S)

Course Description

This course explores an introduction to the analysis of electrical circuits, and use of analytical techniques based on the application of circuit laws and network theorems. Moreover, this course analyzes the DC and AC circuits containing resistors, capacitors, inductors, dependent sources, operational amplifiers, and/or switches. In addition, this course also explores natural and forced responses of first and second order RLC circuits, the use of phasors, AC power calculations, power transfer, and energy concepts. PREREQUISITE: PHYS G280. COREQUISITE: MATH G285. Transfer Credit: CSU; UC. C-ID: ENGR 260; ENGR 260L. **C-ID:** ENGR 260; ENGR 260L.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Utilize a computer circuit analysis program to analyze DC and AC circuits.
3. Work with electronic test equipment to analyze circuits. This will include voltmeters, ammeters, DC power supplies, function generators, and oscilloscopes.
4. Analyze the electrical behavior of DC, AC, and switching transients circuits mathematically.

Course Objectives

- 1. Use techniques of mesh and nodal analysis.
- 2. Apply Thevenin?s and Norton?s theorems to analysis of circuits.
- 3. Solve first and second order transient problems.
- 4. Find the transient response and complete response for RC, RL, and RLC circuits involving DC sources.
- 5. Use oscilloscopes and amplifiers.
- 6. Use diodes in combination with other electric components.
- 7. Implement rectifiers and power supplies.
- 8. Analyze DC circuits to find current, voltage, resistance, power, and/or energy.
- 9. Draw and label circuit diagrams and show thorough mathematical solutions.
- 10. Apply different circuit analysis techniques and demonstrate a process for selecting an appropriate technique for a given problem.
- 11. Solve circuits containing two or more Op Amps.
- 12. Solve AC circuits by using Phasors.
- 13. Calculate average and complex power for AC circuits.

Lecture Content

Definitions and basic concepts Systems of Units Definition of Charge, Current, Voltage, and Power Definition of a Circuit Electrical Power and Energy Circuit Elements: Energy Sources and Resistors Electrical Power and Energy Fundamental laws Ohm's Law Kirchoff's Laws Series and Parallel Circuits Simple circuit analysis Voltage and Current Division Combining Resistors and Energy Sources Operational amplifiers Voltage gain and current limitations of non-ideal op amp circuits DC Analysis techniques Nodal and Mesh Analysis Superposition Source transformations Introduction to DC analysis with SPICE circuit analysis computer program DC Circuit analysis and operational amplifiers Dependent Sources Thevenin's and Norton's Theorems Thevenin and Norton Equivalent Circuits Nodal Analysis of Operational Amplifiers Superposition Operational Amplifiers and Analysis using Ideal Models Inductors and capacitors Defining Calculus Equations for an Inductor Defining Calculus Equations for a Capacitor Inductance and Capacitance Combinations Duality Natural response of RL and RC circuits Properties of Exponential Waveforms Transient and Complete response of RL Circuit Analysis Transient and Complete response of RC Circuit Analysis Transient and Complete response of RLC Circuits Analysis Forced response of RL and RC circuits Unit-Step Forcing Function Combined Natural and Forced Responses Other Transient Analysis of RL and RC Circuits Transient behavior of RCL circuits Types of Natural Responses Overdamped Circuits Underdamped Circuits Critically Damped Circuits Combined Natural and Forced Responses Characteristics of sinusoidal waveforms and sinusoidal steady-state analysis Amplitude, Frequency, and Phase Shift Circuit Response to Sinusoidal Waveforms Sinusoidal steady-state analysis Power factor Phasors The Complex Forcing Function Representing Sinusoids with Phasors Phasor Relationships of RLC Components Circuit response to sinusoids Complex Impedance and Admittance Nodal and Mesh analysis Superposition and Thevenin's Theorem Phasor Diagrams Frequency response of first and second order AC circuits Frequency Response Circuit Responses as Frequency Varies Bode Plots AC Power Instantaneous and Average AC Power Effective (RMS) Values of Voltage and Current Apparent Power, Power Transfer, and Power Factor correction Three phase power (optional)

Lab Content

Test and Measurement equipment: Use of each item for specific purposes Circuit construction techniques for laboratory use (breadboarding) Component identification and labeling Nominal and measured values Limitations on voltage, current, power dissipation Verifying lecture concepts KCL KVL OHM'S Law and Kirchoff's Law Voltage and Current Division Power dissipation Series and parallel circuits Equivalent circuits Superposition Thevier equivalent circuits Basic instrumentation (resistors, capacitors, inductors) Circuit construction techniques Oscilloscopes, multimeters, function generators, power supplies Operational amplifiers and the practical voltage and current limits on the output of these devices. Step and frequency response of RL, RC, RLC circuits Frequency response of RL, RC, and RLC circuits (including resonance) Series and parallel resonance Diodes Rectifier circuits Laboratory safety

Method(s) of Instruction

- Lecture (02)
- Lab (04)

Instructional Techniques

A. Lectures B. Discussion of homework assignments C. Instructor introduction to laboratory exercises D. Use of scientific or graphing calculators to demonstrate problem solutions

Reading Assignments

Textbook

Writing Assignments

Written homework assigned for each problem set corresponding to the lecture.

Out-of-class Assignments

1. Optional professional journal reading assignments. 2. Optional individual/group projects.

Demonstration of Critical Thinking

Build, test, and troubleshoot basic electric circuits. Complete lab assignments that demonstrate these abilities.

Required Writing, Problem Solving, Skills Demonstration

Required writing responses and problem solving exercises on exams, quizzes, and, homework assignments. Students will build, test, and troubleshoot basic electric circuits. They will complete lab assignments that demonstrate these abilities.

Eligible Disciplines

Engineering: Master's degree in any field of engineering OR bachelor's degree in any of the above AND master's degree in mathematics, physics, computer science, chemistry, or geology OR the equivalent. (NOTE: A bachelor's degree in any field of engineering with a professional engineer's license is an alternative qualification for this discipline.) Master's degree required. Title 5, section 53410.1 Engineering technology: Master's degree in any field of engineering technology or engineering OR bachelor's degree in either of the above AND master's degree in physics, mathematics, computer science, biological science, or chemistry, OR bachelor's degree in industrial technology, engineering technology or engineering AND a professional engineer's license OR the equivalent. Master's degree required.

Textbooks Resources

1. Required Hayt, W.H., Kemmerly, J.E., Durbin, S.M.. Engineering Circuit Analysis, ed. Mc Graw Hill, 2019 2. Required Alexander, C.K., Sadiku, M.N.O.. Fundamentals of Electric Circuits, 6 ed. Mc Graw Hill, 2017 3. Required Nilsson, J.W., Riedel, S.. Electric Circuits, 11 ed. Pearson, 2019