

# ENGR A285: ENGINEERING CIRCUITS

Item	Value
Curriculum Committee Approval Date	12/08/2021
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
Grading Policy	Standard Letter (S)

## Course Description

Analysis of electric circuits, including DC circuits, network theorems, energy sources, transient analysis, sinusoidal analysis, phasors, AC power, and frequency response of circuits. Lab will include connection of circuits and observation of circuit behavior using electronic instrumentation. PREREQUISITE: MATH A285 or MATH A285H, or concurrent enrollment; and PHYS A280. Transfer Credit: CSU; UC.

## Course Level Student Learning Outcome(s)

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

## Course Objectives

- 1. Identify basic circuit components on a schematic drawing.
- 2. Analyze electric circuits for voltage, current, power and energy values.
- 3. Use techniques of mesh and nodal analysis.
- 4. Apply Thevenins and Nortons theorems to analysis of circuits.
- 5. Solve first and second order transient problems.
- 6. Find the transient response and complete response for RC, RL, and RLC circuits involving DC sources.
- 7. Use phasors and complex algebra in AC analysis problems.
- 8. Connect electric circuits in the lab.
- 9. Measure resistance, current, AC and DC voltage and power values. Experimentally verify these values for a variety of electrical circuits.
- 10. Test circuits, analyze data and compare measured performance to theory and simulation.
- 11. Use oscilloscopes and amplifiers.
- 12. Use diodes in combination with other electric components.
- 13. Implement rectifiers and power supplies.

- 14. Use a circuit simulation program (e.g. PSpice, Multisim, etc.) and other computer applications (e.g. MATLAB, MS Excel, etc.) to predict or describe circuit behavior.
- 15. Troubleshoot and repair simple electric circuits.
- 16. Record and document results of lab work using text and graphs.
- 17. Work effectively in groups by sharing responsibilities and collaborating on findings.

## Lecture Content

DEFINITIONS AND BASIC CONCEPTS Systems of Units Definition of Charge, Current, Voltage, and Power Definition of a Circuit Circuit Elements: Energy Sources and Resistors FUNDAMENTAL LAWS Ohms Law Kirchoffs Laws Series and Parallel Circuits SIMPLE CIRCUIT ANALYSIS Voltage and Current Division Combining Resistors and Energy Sources Ideal Operational amplifiers Practical Limitations of Operational Amplifiers 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 Thevenins and Nortons Theorems Nodal Analysis of Operational Amplifiers 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 RL Circuit Analysis Transient RC Circuit 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 Amplitude, Frequency, and Phase Shift Circuit Response to Sinusoidal Waveforms PHASORS The Complex Forcing Function Representing Sinusoids with Phasors Phasor Relationships of RLC Components CIRCUIT RESPONSE TO SINUSOIDS Impedance and Admittance Nodal and Mesh analysis Superposition and Thevenins Theorem Phasor Diagrams FREQUENCY RESPONSE 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 and Power Factor

## Lab Content

OHMS LAW AND KIRCHOFFS LAWS SERIES AND PARALLEL CIRCUITS SUPERPOSITION THEVENIN EQUIVALENT CIRCUITS BASIC INSTRUMENTATION (RESISTORS, CAPACITORS, INDUCTORS) COMPONENT IDENTIFICATION AND LABELING; NOMINAL AND MEASURED VALUES; LIMITATIONS ON VOLTAGE, CURRENT, POWER DISSIPATION CIRCUIT CONSTRUCTION TECHNIQUES FOR LABORATORY USE (BREADBOARDING) OSCILLOSCOPES, MULTIMETERS, FUNCTION GENERATORS, POWER SUPPLIES IDEAL VERSUS NON-IDEAL OPERATIONAL AMPLIFIERS STEP AND FREQUENCY RESPONSE OF RL, RC, RLC CIRCUITS SERIES AND PARALLEL RESONANCE DIODES RECTIFIER CIRCUITS LABORATORY SAFETY

## Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)
- Lab (04)

- DE Live Online Lab (04S)
- DE Online Lab (04X)

## Instructional Techniques

Lectures using overhead projector and/or dry erase board  
 Discussion of homework assignments  
 Instructions for laboratory exercises  
 Use of scientific calculators to demonstrate problem solutions

## Reading Assignments

0.75 hrs./week of textbook reading.

## Writing Assignments

2 hrs./week of lab report writing.

## Out-of-class Assignments

4 hrs./week of practice problems.

## Demonstration of Critical Thinking

Written Examinations: Written exams will be used to evaluate the students mastery of lecture and lab material. Practical Examinations: Students will build, test and troubleshoot basic electric circuits. They will complete lab assignments that demonstrate these abilities.

## Required Writing, Problem Solving, Skills Demonstration

Written Examinations: Written exams will be used to evaluate the students mastery of lecture and lab material. Practical Examinations: Students will build, test and troubleshoot basic electric circuits. They will complete lab assignments that demonstrate these abilities.

## Eligible Disciplines

Engineering: Masters degree in any field of engineering OR bachelors degree in any of the above AND masters degree in mathematics, physics, computer science, chemistry, or geology OR the equivalent. (NOTE: A bachelors degree in any field of engineering with a professional engineers license is an alternative qualification for this discipline.) Masters degree required. Title 5, section 53410.1

## Textbooks Resources

1. Required Hayt, W.H., Kemmerly, J.E., Phillips, J., Durbin, S.M.. Engineering Circuit Analysis, 9th ed. McGraw Hill, 2019  
 Rationale:  
 rationale 2. Required Alexander, C.K., Sadiku, M.N.O.. Fundamentals of Electric Circuits, 6th ed. McGraw Hill, 2017  
 3. Required Nilsson, J.W., Riedel, S.. Electric Circuits, 11th ed. Pearson, 2019

## Manuals Resources

1. Boylestad, R.L., Kousourou, G.. Laboratory Manual for Introductory Circuit Analysis, Pearson , 07-19-2015

## Other Resources

1. Spice Circuit analysis program (student version)