ENGR 0260L - ELECTRIC CIRCUITS LABORATORY

Catalog Description

Formerly known as ENGR 17L
Prerequisite: Completion of PHYS 210 and 210L with grades of "C" or better
Corequisite: Concurrent enrollment in ENGR 260
Hours: 54 laboratory
Description: An introduction to the construction and measurement of electrical circuits. Basic use of electrical test and measurement instruments including multimeters, oscilloscopes, power supplies, and function generators. Use of circuit simulation software. Interpretation of measured and simulated data based on principles of circuit analysis for DC, transient, and sinusoidal steady-state (AC) conditions. Elementary circuit design. Practical considerations such as component value tolerance and non-ideal aspects of laboratory instruments. Construction and measurement of basic operational amplifier circuits. (C-ID ENGR 260 L) (CSU, UC)

Course Student Learning Outcomes

- CSLO #1: Write, explain, specify, build, and measure, with engineering design techniques, the common electrical circuit elements (including busses, connectors, resistors, inductors, capacitors, diodes, and transistors).
- CSLO #2: Build and test complex resistive networks by applying various engineering analysis techniques.
- CSLO #3: Analyze, build, and measure complex time variant circuit networks.
- CSLO #4: Analyze, build, and test electrical engineering circuits including DC, AC, Op-amp, and digital logic circuits.
- CSLO #5: Create comprehensive reports to document the design and fabrication process of several different types of circuits comparing theoretical results to those measured within the lab on circuits built by the student.

Effective Term

Fall 2022

Course Type

Credit - Degree-applicable

Contact Hours

54

Outside of Class Hours

0

Total Student Learning Hours

54

Course Objectives

1. Demonstrate the use of common laboratory test equipment following hands-on training
1A Digital Volt Meter (resistance, voltage and current)
1B O-Scope (time variant voltage and current)
1C Function generator
1D Power supply
1E Computer circuit modeling software
2. Solve problems with practical circuits which demonstrate the application of theoretical principles
2A Simple and complex resistive networks
2B Series and parallel combinations of resistors-capacitors-inductors (natural and step response)
2C Mutual inductance
2D time variant DC sources (include switching)
2E steady state sinusoidal source and response
2F Instantaneous and steady state power supplied and consumed
2G Maximum power transferred
2H Operational Amplifiers (single and multiple)
2I Logic Circuits
3. Create lab reports summarizing the theory, procedure, equipment, results and conclusions of various lab experiments

General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- CSU Transferable
- UC Transferable

Methods of Evaluation

- Reports
  - Example: Example 1: Given the sinusoidal steady state circuit that is wired and in operation on the prototype board, use the O-scope to measure the peak value of voltage on the resistor (R1). Compare the frequency of the source to this resistor (R1). Measure the phase shift between the two. Students are required to create detailed lab reports to document and communicate what procedure was followed, equipment used, results obtained and conclusions drawn. Example 2: Read the handout on Lab 2: Voltage Divider Design. From the theory, calculate the theoretical values for resistors R1, R2, R3, Ra, Rb, and Rc. Once complete, obtain resistors of these values and build this circuit on the prototype board. Measure the voltages across all resistors. Compare the theoretical values of voltage on each resistor to the actual value measured on the prototype board. Write a report, including an introduction, theory, procedure, equipment list, results, conclusions, and appendix sections communicating and documenting everything that was done during this lab experiment. Students are also required to generate laboratory report to summarize what was completed during lab. This will clearly explain the theory, procedure, equipment used, results, and conclusions of Lab. Several labs are assigned and listed below. One lab report will be required for each topic. This lab report will include the theoretical values for circuit variables, voltage and current either calculated by hand or by computer, and compare those to the actual physical circuit created and measured by the student, of those same variables. Examples of labs performed for this class are listed below: Example 1: Lab1: DC circuit variable measurement Example 2: Lab2: Design a DC

power supply Example 3: Lab3: RLC Circuit Design (To Create Filters and perform mathematical analysis) Example 4: Lab4: Operational Amplifiers Used to manipulate a signal Example 5: Lab5: Digital Logic Circuits (design and build a simple calculator) etc.

- Skill Demonstrations
  - Example: Example 1: Given the sinusoidal steady state circuit that is wired and in operation on the prototype board, use the O-scope to measure the peak value of voltage on the resistor (R1). Compare the frequency of the source to this resistor (R1). Measure the phase shift between the two. Students are required to create detailed lab reports to document and communicate what procedure was followed, equipment used, results obtained and conclusions drawn. Example 2: Read the handout on Lab 2: Voltage Divider Design. From the theory, calculate the theoretical values for resistors R1, R2, R3, Ra, Rb, and Rc. Once complete, obtain resistors of these values and build this circuit on the prototype board. Measure the voltages across all resistors. Compare the theoretical values of voltage on each resistor to the actual value measured on the prototype board. Write a report, including an introduction, theory, procedure, equipment list, results, conclusions, and appendix sections communicating and documenting everything that was done during this lab experiment. Students are also required to generate laboratory report to summarize what was completed during lab. This will clearly explain the theory, procedure, equipment used, results, and conclusions of Lab. Several labs are assigned and listed below. One lab report will be required for each topic. This lab report will include the theoretical values for circuit variables, voltage and current either calculated by hand or by computer, and compare those to the actual physical circuit created and measured by the student, of those same variables. Examples of labs performed for this class are listed below: Example 1: Lab1: DC circuit variable measurement Example 2: Lab2: Design a DC power supply Example 3: Lab3: RLC Circuit Design (To Create Filters and perform mathematical analysis) Example 4: Lab4: Operational Amplifiers Used to manipulate a signal Example 5: Lab5: Digital Logic Circuits (design and build a simple calculator) etc.

Repeatable

No

Methods of Instruction

- Laboratory

Lab:

1. A Lecture is prepared using lecture slides to present the theory used to analyze resistive DC circuits by method of mesh current analysis. During this lecture several pictures, diagrams, example problems with solutions are presented. Following this, the instructor leads an interactive discussion further explaining and answering questions. Two example problems are demonstrated by the instructor at appropriate times throughout the presentation. Students are then asked to participate and given time to work through additional, similar problems. Students are encouraged to take detailed notes and ask questions to clarify any misunderstanding during the lecture and problem solving forum.
2. Based on the above lecture, students then wire up an actual circuit using real, physical devices and then actually measure the circuit variables (voltage and current) the theoretical values (hand calculations) are then compared to the actual values (physical devices that are wired and measured). Items
3.) and
4.) are then repeated two weeks later for the next, successive labs: RLC controls, RLC filters, Operational amplifiers, digital circuits.

Typical Out of Class Assignments
Reading Assignments

1. Read chapter in the textbook on root-mean-square (rms) power measurement versus peak power measurement. Come to lab prepared to discuss and then demonstrate the measurement of RMS and peak values of voltage and current on an electrical circuit wired by the student. 2. Read the lab procedure on operating the O-scope. Perform the tutorial that is attached to the lab procedure. This will begin to prepare one for the O-scope labs. After reading through the procedure and tutorial, take the time outside of class to perform the procedures described therein.

Writing, Problem Solving or Performance

1. Create a written lab report that will clearly explain the theory, procedure, equipment used, results, and conclusions of Lab experiment #1, DC voltage measurement. 2. Given the network of resistors connected in series and parallel as shown in the circuit below, use the mesh-current method to solve for all circuit variables (voltage and current in each device). Now create this circuit on a prototype board and measure these values. Compare and contrast the theoretical values (calculated) to the actual voltage and current measured on the circuit.

Other (Term projects, research papers, portfolios, etc.)
Required Materials

- Electric Circuits
  - Author: J. Nilsson, S. Riedel
  - Publisher: Prentice Hall
  - Publication Date: 2018
  - Text Edition: 11th
  - Classic Textbook?:
  - OER Link:
  - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.