EET-1161: DIRECT CURRENT CIRCUITS

Cuyahoga Community College

Viewing: EET-1161 : Direct Current Circuits

Board of Trustees:
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Academic Term:
Fall 2022

Subject Code
EET - Electrical/Electronic Engineer

Course Number:
1161

Title:
Direct Current Circuits

Catalog Description:
Introduction to direct current circuits that includes engineering notation, the meaning of voltage, current, resistance (including color code), electrical units, power dissipation, the American Wire Gauge (AWG) table, Ohm's Law, Kirchoff's Voltage Law (KVL), Kirchoff's Current Law (KCL), series circuits, parallel circuits, series/parallel circuits, component troubleshooting, resistor-capacitor (RC) and resistor-inductor (RL) circuits (charge, discharge and time constants). Circuit theorems include Thevenin and Norton equivalent circuits, mesh and nodal analysis.

Credit Hour(s):
3

Lecture Hour(s):
2
Lab Hour(s):
3

Requisites

Prerequisite and Corequisite
MATH-0955 Beginning Algebra, or concurrent enrollment; qualified Math placement; or departmental approval.

Outcomes

Course Outcome(s):
Utilize the correct terminology in reference to circuit parameters.

Objective(s):
1. Correctly use prefixes regarding electric/electronic circuits.
2. Correctly use units of parameter measure in electrical/electronic circuits.
3. Demonstrate knowledge of color code by selecting the correct components for laboratory experiments.

Course Outcome(s):
Demonstrate conversion to/from scientific and engineering notations.

Objective(s):
1. Convert a rational or irrational number to/from scientific notation form.
2. Convert a rational or irrational number to/from engineering notation.

Course Outcome(s):
Calculate voltage, current, and resistance using Ohm's Law.

Objective(s):

1. Explain the relationship between current, voltage, resistance, and power in a DC circuit.
2. Perform theoretical calculations preceding laboratory experiments.
3. Mathematically determine and explain the relationship between resistance and conductance.
4. Determine the voltage drop and voltage relative to ground for a circuit fed by a positive and negative voltage source.

Course Outcome(s):

Demonstrate use of the three forms of power equations and explain the difference between power and energy.

Objective(s):

1. Use and derive (if necessary) the three forms of power equations.
2. Explain the relationship between power and energy and calculate energy conversion in Joules and Watt-seconds.

Course Outcome(s):

Apply DC circuit theory to resistive circuits when designing or analyzing regarding the application of Ohm's Law, Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL).

Objective(s):

1. Explain and prove Kirchhoff's Voltage Law theoretically using instrumentation and/or with circuit simulation software.
2. Explain and prove Kirchhoff's Current Law theoretically using instrumentation and/or with circuit simulation software.

Course Outcome(s):

Choose and explain circuit parameters in series circuits.

Objective(s):

1. Calculate the voltage drop using Ohm's Law in a series circuit.
2. Calculate voltage drop by using Voltage Divider Rule.
3. Calculate the total resistance in a series circuit.
4. Calculate the total current in a series circuit.

Course Outcome(s):

Choose and explain circuit parameters in parallel circuits.

Objective(s):

1. Calculate the total resistance in a parallel circuit.
2. Determine the current through each branch of a parallel circuit using Ohm's Law.
3. Determine the current through each branch of a parallel circuit using Current Divider Rule.
4. Determine the total current in a parallel circuit.

Course Outcome(s):

Choose and explain circuit parameters in series-parallel circuits.

Objective(s):

1. Determine the total current through a series/parallel circuit.
2. Determine the total resistance in a series/parallel circuit.
3. Calculate the current through a parallel branch of a series/parallel circuit.
4. Calculate the voltage drop across series elements of a series/parallel circuit.

Course Outcome(s):

Demonstrate the conditions where maximum power transfer occurs in a DC circuit.

Objective(s):

1. Explain the difference between load resistance and the internal resistance of a power supply.
2. Graph the power transferred to a load with the internal resistance fixed and the load resistance variable.

Course Outcome(s):
Choose theoretical, simulated and measured circuit parameters using network theorems and other advanced analysis techniques.

Objective(s):

1. Mesh Analysis: Write and solve a second order (two mesh loops) system of linear equations and then use instrumentation and/or circuit simulation software to prove the solution. Use the elimination or substitution method.
2. Mesh Analysis: Write a loop equation for a three mesh circuit and solve with a calculator.
3. Nodal Analysis: Write and solve an equation for a single nodal network and use instrumentation and/or circuit simulation software to verify the result.
4. Nodal Analysis: Write and solve an equation for a two node network and solve with a calculator.
5. Superposition Theorem: Write the equations and solve using superposition a circuit with two sources.
6. Simplify circuits using Thevenin's Theorem.
7. Convert Thevenin equivalent circuits to/from Norton equivalent circuits.

Course Outcome(s):
Measure and explain the time constant of a resistor-capacitor circuit.

Objective(s):

1. Calculate the time constant for a resistor-capacitor circuit.
2. Measure the time constant for a resistor-capacitor circuit using an oscilloscope or circuit simulation software.

Course Outcome(s):
Measure and explain the time constant of a resistor-inductor circuit.

Objective(s):

1. Calculate the time constant for a resistor-inductor circuit.
2. Measure the time constant for a resistor-inductor circuit using an oscilloscope or circuit simulation software.

Course Outcome(s):
Apply instrumentation using power supplies and digital multimeters (DMMs) in DC circuits.

Objective(s):

1. Demonstrate in lab the experimental results and reconcile any difference from the theoretical calculations.
2. Demonstrate in lab the experimental results and reconcile any difference from software simulation results.
3. Demonstrate the proper use of voltmeters, ammeters, and ohmmeters.
4. Interpret the display of instrumentation equipment.
5. Troubleshoot errors in laboratory wiring with minimum instructor assistance.
6. Demonstrate the application of circuit theory when diagnosing the trouble boards with through hole and surface mount components.
7. Troubleshoot electrical circuits using instrumentation, visual inspection, sound, and smell.

Course Outcome(s):
Use calculators and mathematical software tools such as Excel to verify underlying principals of electronic circuits in context.

Objective(s):

1. Establish the mathematical relationship of an electronic component by varying one property while holding the other properties constant (determine if one property is a function of another).
2. Graph linear equations and determine the rate of change.
3. Demonstrate using electronic equipment how absolute values relate to voltage drop.
4. Graph power dissipation relative to rated power using inequalities.
5. Simplify electronic equations to isolate a variable using symbols or parameters that are numbers.
6. Use the rules of exponents to solve mathematical problems related to electronics.

Course Outcome(s):
Demonstrate the use of circuit simulation software.

Objective(s):

1. Design a circuit in the simulation workspace.
2. Use software current and voltage probes to display circuit values.
3. Use simulated DMM to display circuit values.

Course Outcome(s):

Construct and test an electronic project that involves soldering.

Objective(s):

1. Construct an electronic project that includes skills to read and interpret schematic and pictorial diagrams.
2. Solder an electronic project that is in accord with good soldering practices that includes no bridging and filled printed circuit board holes (with solder) and/or properly soldered surface mount devices.
3. Using instrumentation, test the electronic project to ascertain that it functions properly.

Methods of Evaluation:

1. Tests
2. Quizzes
3. Laboratory Reports
4. Homework
5. Projects

Course Content Outline:

1. Concepts
    a. Series-parallel circuits
        i. Networks (problem solving)
        ii. Voltage divider supply
    b. Use of graphing calculator's functions to solve systems of linear equations
    c. Circuit analysis techniques
        i. Current sources
        ii. Branch circuit analysis
        iii. Mesh analysis
        iv. Nodal analysis
        v. Bridge networks
        vi. Thevenin's Theorem
        vii. Norton's Theorem
    d. Capacitance
        i. Electric field
        ii. Definition, symbol, and units
        iii. Physical characteristics
        iv. Series and parallel characteristics
        v. RC series, parallel and series-parallel networks
    e. Laboratory topics
        i. Problem solving and calculator usage
        ii. Meter reading and measuring
        iii. Resistor color code and resistor measuring
        iv. Ohm's Law
        v. Series-parallel circuits
        vi. Methods of analysis
        vii. Thevenin's Theorem
        viii. Capacitors
        ix. Computer circuit simulation
        x. Soldering
    f. Safety concerns
        i. Eye protection
        ii. High voltage

2. Skills
    a. Using scientific or engineering notation
    b. Performing theoretical calculations
    c. Relating lab results to theoretical calculations
    d. Using a voltmeter
    e. Using an ammeter
    f. Using an ohmmeter
    g. Interpreting instrument displays
    h. Troubleshooting wiring errors
    i. Troubleshooting electrical circuits
    j. Diagnosing trouble boards with through-hole and surface mount parts
    k. Designing a circuit
    l. Using electric circuit simulation software
    m. Transforming schematic diagrams into correctly wired circuits
    n. Transforming pictorial diagrams into correctly wired circuits
    o. Interpolation when using analog metered test equipment
    p. Work effectively and efficiently in teams
    q. Use of a computer as a form of electronic instrumentation
    r. Decision-making when experimental results do not match theoretical results

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Resources

Boylestad, Robert L. *Introductory Circuit Analysis*. 13th ed. Prentice Hall, 2015.

Floyd, Thomas L. and David M. Buchla. *Principles of Electric Circuits*. 10th ed. Prentice Hall, 2019.

Alexander, Charles and Matthew Sadiku. *Fundamentals of Electric Circuits*. 7th ed. McGraw-Hill, 2020.

Hayt, William H., Jack Kemmerly, Jamie Phillips, and William Durbin. *Engineering Circuit Analysis*. 9th ed. McGraw-Hill, 2018.

Tri-C Faculty. *EET-1161 DC Circuits Lab Manual*. 2020.

Instructional Services

OAN Number:

Transfer Assurance Guide OET001 and Career Technical Assurance Guide CTEET001

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