Western Technical College

10660117 DC Circuit Analysis

Course Outcome Summary

Course Information

Description	This course uses theory, laboratory investigation, to introduce basic electrical and circuit analysis principles. Emphasis is placed on direct current (DC) circuits containing voltage and current sources and resistor networks in series, parallel, and series-parallel configurations. This course also introduces the concepts of electric and magnetic fields in the context of capacitors and inductors and their transient responses in DC circuits.
Career Cluster	Manufacturing
Instructional Level	Associate Degree Courses
Total Credits	2
Total Hours	54

Textbooks

Delmar's Standard Textbook of Electricity. 7th Edition. Copyright 2020. Herman, Stephen. Publisher: Cengage Learning. **ISBN-13:** 978-1-337-90034-8. Required.

Success Abilities

1. Cultivate Passion: Enhance Personal Connections
2. Cultivate Passion: Expand a Growth-Mindset
3. Live Responsibly: Develop Resilience
4. Live Responsibly: Embrace Sustainability
5. Live Responsibly: Foster Accountability
6. Refine Professionalism: Act Ethically
7. Refine Professionalism: Improve Critical Thinking
8. Refine Professionalism: Participate Collaboratively
9. Refine Professionalism: Practice Effective Communication

Program Outcomes

1. Perform work safely.
2. Troubleshoot electrical and mechanical systems and devices.
3. Repair electrical and mechanical systems.
4. Communicate technical information.

Course Competencies

1. Analyze how atomic theory applies to components and properties of basic DC electrical circuits.

Assessment Strategies

1.1. Written Objective Test
1.2. Demonstration

Criteria

You will know you are successful when

1.1. you describe the model of an atom.
1.2. you cite the theory of electrical charges.
1.3. you Identify the significance of the electron as it relates to voltage and current.
1.4. you describe the electrical characteristics of an insulator.
1.5. you describe the electrical characteristics of a conductor.
1.6. you describe the electrical characteristics of a semiconductor.

Learning Objectives

1.a. Describe the model of an atom.
1.b. Explore the theory of electrical charges.
1.c. Identify the significance of the electron as it relates to voltage and current.
1.d. Differentiate the electrical characteristics of an insulator, conductor, and a semiconductor.

2. Demonstrate proper use of electronic symbols, standards, and terminology.

Assessment Strategies

2.1. Demonstration
2.2. Written Objective Test

Criteria

You will know you are successful when

2.1. you associate engineering notation powers of ten to the standard metric prefix and symbol for each.
2.2. you assign the name for electrical and magnetic quantities and units to the correct SI symbol.
2.3. you select the correct electrical component for circuit assembly from a schematic diagram.
2.4. you sketch common electrical schematic symbols and electrical paths on a circuit diagram using either conventional or electron flow.
2.5. you label correct polarities across components.
2.6. you contrast electron flow and conventional flow used in circuit analysis.

Learning Objectives

2.a. Associate engineering notation powers of ten to the standard metric prefix and symbol for each.
2.b. Assign the name for electrical and magnetic quantities and units to the correct SI symbol.
2.c. Select the correct electrical component for circuit assembly from a schematic diagram.
2.d. Sketch electrical paths on a circuit diagram using either conventional or electron flow.
2.e. Label correct polarities across components.
2.f. Contrast electron flow and conventional flow used in circuit analysis.

3. Measure basic DC electrical quantities with appropriate equipment.

Assessment Strategies

3.1. Demonstration

3.2. Written Objective Test

Criteria

You will know you are successful when

3.1. you measure voltage in a DC circuit, using the appropriate meter and meter configuration.
3.2. you measure current in a DC circuit, using the appropriate meter and meter configuration.
3.3. you measure resistance in a DC circuit, using the appropriate meter and meter configuration.
3.4. you use digital meters to measure currents, voltages, and resistances in live circuits.
3.5. you measure the effect of voltmeter loading in circuits.
3.6. you examine practical application of series and parallel connections for current and voltmeters.

Learning Objectives

3.a. Measure values in a DC circuit utilizing a digital multimeter (DMM).
3.b. Measure voltage in a DC circuit.
3.c. Measure current in a DC circuit.
3.d. Measure resistance in a DC circuit.
3.e. Investigate digital multi-meters
3.f. Explain the voltmeter loading
3.g. Understand ohmmeters operation as a powered device
3.h. Explain the constant high series resistance of a digital volt meter (DVM)

4. Examine electronic power connections of circuits.

Assessment Strategies

4.1. Written Objective Test
4.2. Demonstration

Criteria

You will know you are successful when

4.1. You recognize different switch, fuse, and circuit breaker types.
4.2. You identify parts of switches, and circuit breakers.
4.3. You read schematics containing different switch, fuse, and circuit breaker symbols.
4.4. You replace appropriate fuses in lab equipment as required.

Learning Objectives

4.a. Describe different types of switches and fuses
4.b. Identify Schematic symbols of switches and fuses
4.c. Define switch terminology such as pole and throw
4.d. Explain the purpose of fuses and circuit breakers

5. Examine electronic resistors.

Assessment Strategies

5.1. Written Objective Test
5.2. Demonstration

Criteria

You will know you are successful when

5.1. You identify different physical resistor types in lab exercise.
5.2. You determine resistor values using the color code.
5.3. You measure resistance of a component both in and out of a circuit using a DMM.
5.4. You differentiate between a rheostat and a potentiometer.
5.5. You determine power ratings of physical resistors in a lab exercise.
5.6. you interpret schematics containing various resistor symbols.

Learning Objectives

5.a. Describe different types of resistors
5.b. Identify resistor schematic symbols
5.c. Interpret resistor color codes
5.d. Describe types of variable resistors
5.e. Explain resistor power ratings
5.f. Measure resistance of components in and out of a circuit

6. Apply fundamental electronic formulas: Ohms Law and the Power equation.

Assessment Strategies

6.1. Written Objective Test
6.2. Demonstration

Criteria

You will know you are successful when

6.1. you define the term DC voltage, and the relationship between V,I and R in a circuit using Ohm's law.
6.2. you define the term power in a DC circuit using Watts law.
6.3. you calculate values of V, I, R, and P given various circuit scenarios.
6.4. you predict to changes that will occur in a circuit given a value change of I, R, V, or P.
6.5. you answer questions about thought experiments involving circuits with shorts or opens.
6.6. you can build the circuit, measure the values with the appropriate meter, and verify the measured results to calculated values.

Learning Objectives

6.a. Define DC current, resistance, DC voltage, in a circuit using Ohm's law.
6.b. Define power in a DC circuit using Watts law.
6.c. Define the relationship of voltage, current, and resistance in a DC circuit.
6.d. Rewrite ohms law and the power equation to solve for any value
6.e. Calculate I, V, R, and P using ohms law and the power equation
6.f. Explain what an open or a short is in an electronic circuit as the resistor value of ohms law or the power equation
6.g. Predict the effect of an open or a short in an electronic circuit using ohms law and the power equation
6.h. Explain the inverse relationship between I and R when V is constant using ohms law
6.i. Explain the direct relationship between V and I when R is constant using ohms law
6.j. Explain the effect of non-liner resistances on current using ohms law
6.k. Define power using the power equation
6.l. Explain power’s relationship to work and energy
6.m. Determine resistor value required and its required power rating for electronic circuits using ohm’s law and the power equation

7. Investigate and troubleshoot DC circuits.

Assessment Strategies

7.1. Written Objective Test
7.2. Demonstration

Criteria

You will know you are successful when

7.1. you calculate circuit values of a series and parallel circuit.
7.2. you measure voltage, current, and resistance in series and parallel circuits.
7.3. you understand and apply the rules of a series and parallel circuit.
7.4. you calculate circuit values of a series-parallel circuit.
7.5. you measure circuit values of a series-parallel circuit.
7.6. you use appropriate test equipment to determine circuit failure.
7.7. you determine if a short circuit condition exists.
7.8. you determine if an open circuit condition exists.
7.9. you repair failing DC circuits.

Learning Objectives

7.a. Explain a series circuit, parallel circuit, and a series-parallel circuit.
7.b. Analyze the operation of a series circuit, parallel circuit, and a series-parallel circuit.
7.c. Solve for unknown circuit values given other circuit values, I, V, R, and P.
7.d. Use appropriate test equipment to determine circuit failure.
7.e. Determine the cause of DC circuit failures.
7.f. Repair failing DC circuits.

8. Investigate the principles of magnetism and electromagnetism.

Assessment Strategies

8.1. Written Objective Test
8.2. Demonstration

Criteria

You will know you are successful when

8.1. you understand the principles of a magnetic field surrounding a current carrying conductor.
8.2. you understand the principles of a magnetic field surrounding a permanent and electro-magnet.
8.3. you explain the effects of magnetic field interaction.
8.4. you demonstrate the operation of a relay and solenoid.

Learning Objectives

8.a. Memorize the principles of a magnetic field surrounding a current carrying conductor.
8.b. Memorize the principles of a magnetic field surrounding a permanent and electro-magnet.
8.c. Explain the effects of magnetic field interaction.
8.d. Demonstrate the operation of a relay and solenoid.
8.e. Explain the operation of a motor.
8.f. Differentiate the operation of the three most common electromagnetic devices.

9. Examine Capacitors in a DC Circuit.

Assessment Strategies

9.1. Written Objective Test
9.2. Demonstration

Criteria

You will know you are successful when

9.1. you understand capacitor ratings.
9.2. you measure capacitance with RLC Meter and DMM.
9.3. you determine capacitance using capacitor code tables.
9.4. you calculate capacitance in series and parallel capacitor circuits.
9.5. you calculate, build and measure RC time constants circuits.
9.6. you analyze the function of a capacitor.

Learning Objectives

9.a. Explore the parts of a capacitor
9.b. Explore the function of a capacitor in a DC Circuit
9.c. Explore types of capacitors.
9.d. Explore capacitor rating codes.
9.e. Explore DC based RC circuits.
9.f. Explore RC time constants in a DC circuit.
9.g. Explore capacitance values with capacitors in series and parallel.

10. Examine Inductor in a DC Circuit.

Assessment Strategies

10.1. Written Objective Test
10.2. Demonstration

Criteria

You will know you are successful when

10.1. you analyze the function and operation of an inductor.
10.2. you measure Inductance with a RLC Meter.
10.3. you determine inductance using a inductance code table.
10.4. you calculate inductance in series and parallel inductor circuits.

Learning Objectives

10.a. Explore the parts of an inductor.
10.b. Explore the function of an inductor in a DC Circuit.
10.c. Explore types of inductors.
10.d. Explore inductor rating codes.
10.e. Explore DC based RC circuits.
10.f. Explore RC time constants in a DC circuit.

10.g. Explore inductance values with inductors in series and parallel.

11. Examine how voltage and current flow are controlled in DC circuits.

Assessment Strategies

11.1. Written Objective Test
11.2. Demonstration

Criteria

You will know you are successful when

11.1. you explain the atomic differences between conductors, semiconductors, and insulators.
11.2. you describe how to forward-bias and reverse-bias silicon diodes.
11.3. you display the characteristic curve of a silicon diode.
11.4. you test silicon diodes using a DMM.
11.5. you construct a zener regulator circuit and explain its proper operation.
11.6. you measure the output voltage of constructed zener regulator circuits to verify circuit calculations.
11.7. you describe the advantages of an IC voltage regulator over a simple zener regulator circuit.
11.8. you describe the operation and characteristics of LEDs and photodiodes.
11.9. you explain the importance of power supply line and load regulation.

Learning Objectives

11.a. Discuss semiconductors, conductors, and insulators in regards to their differences.
11.b. Describe the properties of n-type and p-type semiconductors.
11.c. Describe a pn junction and how it is formed.
11.d. Discuss methods of biasing a pn junction.
11.e. Test diodes using a DMM.
11.f. Describe the characteristics of a zener diode and analyze its operation.
11.g. Construct circuits to observe or measure a zener diode's volt-ampere characteristics.
11.h. Calculate the current and voltage in a zener voltage regulator circuit with varying loads.
11.i. Test the current and voltage in a zener voltage regulator circuit with varying loads.
11.j. Discuss the operation and characteristics of LEDs.
11.k. Construct a circuit to determine the characteristics of an LED.
11.l. Discuss the basic concept of voltage regulation.
11.m. Explain line and load regulation.
11.n. Describe the operation of three-terminal IC voltage regulators.

12. Explore AC Voltage.

Assessment Strategies

12.1. Skill Demonstration
12.2. Written Objective Test

Criteria

You will know you are successful when

12.1. you calculate AC wavelength, period and frequency.
12.2. you measure AC wavelength, period and frequency.
12.3. you calculate AC voltage peak, voltage peak to peak, and voltage RMS.
12.4. you measure AC voltage peak, voltage peak to peak, and voltage RMS.

Learning Objectives

12.a. Investigate AC wavelength, period and frequency.
12.b. Investigate the relationship between AC voltage peak, voltage peak to peak, and RMS.
12.c. Measure AC values with appropriate test equipment.