Western Technical College

31660310 Electricity Basics

Course Outcome Summary

Course Information

Description	DC/AC electrical theory and the quantities of voltage, current, resistance and power will be introduced. Ohm's Law, series, parallel and combination circuits are covered along with multi-meter usage, troubleshooting and safety. Sources of DC power, AC generation, 3-phase power, electromagnetism and transformers are discussed. DC and AC characteristics of inductive and capacitive circuits will be introduced. Required math concepts are covered in an applied format along with a significant component of “hands on” lab activities.
Career Cluster	Manufacturing
Instructional Level	Technical Diploma Courses
Total Credits	4.00
Total Hours	144.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture	2 CR / 72 HR
Lab	2 CR / 72 HR

Course History

Last Approval Date	8/5/2015

Pre/Corequisites

Prerequisite	Placement Test Scores ACT (English) 16+, COMPASS (Writing) 56+, ASSET (Writing) 41+, ACCUPLACER (Sentence Skills) 60+
Prerequisite	Placement Test Scores ACT (Math) 17+, COMPASS (PreAlgebra) 47+, ASSET (Numerical) 41+, ACCUPLACER (Arithmetic) 74+
Prerequisite	Placement Test Scores ACT (Reading) 13+, COMPASS (Reading) 60+, ASSET (Reading) 35+, ACCUPLACER (Reading) 45+

Textbooks

Electricity Basic and Intro to Industrial Controls (Custom Book). Petruzella, Frank. Publisher: McGraw-Hill Publishing Company. **ISBN-13**:978-1-3081-1020-2. Required.

Learner Supplies

Scientific calculator - T1-30XIIS. **Vendor:** Campus Shop. Required.

Core Abilities

1. **Apply mathematical concepts.**
   Status *Active*

2. **Demonstrate ability to think critically.**
   Status *Active*

3. **Demonstrate ability to value self and work ethically with others in a diverse population.**
   Status *Active*

4. **Make decisions that incorporate the importance of sustainability.**
   Status *Active*

5. **Transfer social and natural science theories into practical applications.**
   Status *Active*

6. **Use effective communication skills.**
   Status *Active*

7. **Use technology effectively.**
   Status *Active*

Program Outcomes

1. **Adhere to proper safety practices and procedures.**
   Type *Local* ***Code*** * * ***Status*** *Active*

2. **Exhibit professionalism.**
   Type *Local* ***Code*** * * ***Status*** *Active*

3. **Perform preventative maintenance.**
   Type *Local* ***Code*** * * ***Status*** *Active*

4. **Maintain parts and equipment inventory including service documentation.**
   Type *Local* ***Code*** * * ***Status*** *Active*

5. **Maintain electrical and electronic devices and systems.**
   Type *Local* ***Code*** * * ***Status*** *Active*

6. **Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.**
   Type *Local* ***Code*** * * ***Status*** *Active*

Course Competencies

1. **Demonstrate the ability to follow industry established safety procedures.**

Domain *Cognitive* ***Level*** *Applying* ***Status*** *Active*

Linked Core Abilities
Demonstrate ability to think critically.
Demonstrate ability to value self and work ethically with others in a diverse population.
Make decisions that incorporate the importance of sustainability.

Linked Program Outcomes
Adhere to proper safety practices and procedures.
Exhibit professionalism.

Assessment Strategies
1.1. Written Objective Test

Criteria

Performance will be satisfactory when:

1.1. learner passes a written objective test with a score of 75% or above.
1.2. learner familiarizes himself/herself with location of a first-aid kit in their working environment.
1.3. learner familiarizes himself/herself with location, access, and operation of area fire extinguishers.
1.4. learner familiarizes himself/herself with local access system for obtaining emergency help.
1.5. learner familiarizes himself/herself with posted warning signs and their connected procedure or process for full adherence.
1.6. learner describes proper OSHA certified: eye, hand, foot, and head protection for stipulated operations and locations.

Learning Objectives
1.a. List general safety rules for electricity and electronics.
1.b. Locate first-aid supplies, fire extinguishers and circuit breaker panels.
1.c. Discuss OSHA certified: eye, hand, foot, and head protection for stipulated operations and locations.

2. Demonstrate fundamental math skills required for electrical calculations.

Domain *Cognitive* ***Level*** *Applying* ***Status*** *Active*

Linked Core Abilities
Apply mathematical concepts.

Linked Program Outcomes
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies
2.1. Written Objective Test

Criteria

Performance will be satisfactory when:

2.1. learner passes a written objective test with a score of 75% or above.
2.2. learner evaluates expressions containing positive and negative numbers.
2.3. learner calculates percent error.
2.4. learner calculates percent efficiency.
2.5. learner correctly applies percentage calculations in directed applications.
2.6. learner converts numbers between decimal and metric prefixed forms.
2.7. learner converts numbers between metric prefixed and engineering notational forms.
2.8. learner performs calculations with expressions in metric prefixed and engineering notational form.
2.9. learner converts between Watts and horse power.

Learning Objectives
2.a. Solve expressions by applying proper order of operations.
2.b. Convert between fractional and decimal forms of numbers.
2.c. Solve expressions containing positive and negative numbers.
2.d. Solve expressions containing square roots and exponenents.

2.e. Compute values utilizing percentage.
2.f. Convert numbers between decimal, engineering notation and metric prefixed forms.
2.g. Calculate expressions in engineering notation using a calculator.

3. Apply basic algebra and right triangle trigonometry to electrical concepts.

Domain *Cognitive* ***Level*** *Applying* ***Status*** *Active*

Linked Core Abilities

Apply mathematical concepts.

Linked Program Outcomes

Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

3.1. Written Objective Test

Criteria

Performance will be satisfactory when:

3.1. learner passes a written objective test with a score of 75% or above.
3.2. learner rearranges three variable equations to solve for a specific variable.
3.3. learner solves three variable equations.
3.4. learner graphs three variable equations.
3.5. learner interprets graphs.
3.6. learner correctly identifies the hypotenuse, opposite and adjacent sides of a given right triangle.
3.7. learner solves for the missing angle of a right triangle under given parameters.
3.8. learner calculates the sine, cosine, and tangent of any angle of a right triangle.
3.9. learner applies the Pythagorean Theorem to calculate a given side of a right triangle.

Learning Objectives

3.a. Rearrange three variable equations to solve for a specific variable.
3.b. Solve three variable equations.
3.c. Graph three variable equations.
3.d. Interpret graphs.
3.e. Identify the hypotenuse, opposite and adjacent sides of a given right triangle.
3.f. Solve for the missing angle of a right triangle under given parameters.
3.g. Calculate the sine, cosine, and tangent of any angle of a right triangle.
3.h. Apply the Pythagorean Theorem to calculate a given side of a right triangle.

4. Explore the properties of a basic electrical circuit.

Domain *Cognitive* ***Level*** *Analyzing* ***Status*** *Active*

Linked Core Abilities

Demonstrate ability to think critically.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

4.1. Skill Demonstration
4.2. Written Objective Test

Criteria

Performance will be satisfactory when:

4.1. learner passes a written objective test with a score of 75% or above.
4.2. learner passes a skill performance test with a score of 75% or above.
4.3. learner explains the requirements of a complete electrical circuit.
4.4. learner differentiates between an open circuit condition and a closed circuit condition.
4.5. learner follows safety guidelines when circuit is attached to a source.
4.6. learner defines the terms "pole" and "throw" as they relate to mechanical switches.
4.7. learner applies simple switching devices to open and close electrical circuits.
4.8. learner successfully completes required electrical circuit construction activities.

Learning Objectives

4.a. Describe the requirements of a basic electrical circuit.
4.b. Identify the schematic symbols of the components of a simple electrical circuit.
4.c. Apply simple switching devices to open and close electrical circuits.
4.d. Differentiate between an open circuit condition and a closed circuit condition.
4.e. Become familiar with a variety of switch types.
4.f. Define the terms "pole" and "throw" as they relate to mechanical switches.
4.g. Introduce typical circuit protection devices.

5. Investigate electrical quantities and their characteristics

Domain *Cognitive* ***Level*** *Analyzing* ***Status*** *Active*

Linked Core Abilities

Demonstrate ability to think critically.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

5.1. Written Objective Test

Criteria

Performance will be satisfactory when:

5.1. learner passes a written objective test with a score of 75% or above.
5.2. learner explains the differences between conductors, insulators and semiconductors as they apply to the atomic model.
5.3. learner lists the most common materials used as insulators and conductors.
5.4. learner explains the theory of electrical charges.
5.5. learner properly describes voltage, current, resistance and power as they apply to an electrical circuit.
5.6. learner correctly calculates values of Voltage, Current, Resistance and Power in a single resistor circuit utilizing Ohm's and Watt's Laws.
5.7. learner correctly explains the difference between "electron flow" and "conventional" current flow.

Learning Objectives

5.a. Describe the model of an atom, naming the characteristics of its structure and associative connection to electronics.
5.b. Discuss the theory of electrical charges.
5.c. Explain the differences between conductors, insulators and semiconductors as they apply to the atomic model.
5.d. Describe voltage, current, resistance and power as they apply to an electrical circuit.
5.e. Calculate values of voltage, current, resistance and power in a single component circuit using Ohm's and Watt's Laws.
5.f. Discuss the conceptual differences between electron flow and conventional current flow.

5.g. Identify fixed resistor component values and tolerances using the EIA color code.
5.h. Use Ohm's Law and Watt's Law to determine the resistance and wattage ratings for resistors used in electronic circuits.

5.i. Calculate energy consumption and apply cost factors.

6. Measure electrical quantities.

Domain *Psychomotor* ***Level*** *Practicing* ***Status*** *Active*

Linked Core Abilities

Demonstrate ability to think critically.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

6.1. Skill Demonstration

Criteria

Performance will be satisfactory when:

6.1. learner passes a skill performance test with a score of 75% or above.
6.2. learner chooses appropriate instrumentation for measuring DC and AC electrical quantities.
6.3. learner properly measures electrical quantities in both AC and DC circuits.
6.4. learner measures electrical quantities with both analog and digital multimeters.
6.5. learner selects appropriate resolving meter range with non-autoranging multimeter; for voltage, current, and ohmic values.
6.6. learner accurately measures AC waveforms with an oscilloscope or scopemeter as directed.

Learning Objectives

6.a. Choose appropriate instrumentation for measuring DC and AC electrical quantities.
6.b. Measure resistance in an unpowered electrical circuit with both analog and digital meters.
6.c. Measure voltage in a DC circuit.
6.d. Measure current in a DC circuit.
6.e. Measure voltage in an AC circuit
6.f. Measure current in an AC circuit
6.g. Measure power in an AC circuit.
6.h. Measure AC waveform values with an oscilloscope or scopemeter.

7. Explore electrical circuit configurations

Domain *Cognitive* ***Level*** *Analyzing* ***Status*** *Active*

Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

7.1. Skill Demonstration
7.2. Written Objective Test

Criteria

Performance will be satisfactory when:

7.1. learner passes a written objective test with a score of 75% or above.
7.2. learner passes a skill performance test with a score of 75% or above.
7.3. learner reduces a series resistive circuit to an equivalent resistance.
7.4. learner calculates, using Ohm's Law and Watt's Law, all electrical quantities for series resistive circuits.
7.5. learner identifies a series electrical path.
7.6. learner calculates voltage drops, using Kirchoff's Voltage Law and the voltage divider rule, for all resistive values in open and closed series resistive circuits.
7.7. learner builds lab circuits to operate to specified tolerances.
7.8. learner identifies a parallel resistive circuit containing a multiple number of resistors.
7.9. learner applies Ohm's Law and Watt's Law to obtain all values of parallel circuit models.
7.10. learner calculates total circuit resistive values in parallel circuits.
7.11. learner verifies calculated values with working models for parallel circuits.
7.12. learner reduces a combinatorial series - parallel resistive circuit to an equivalent resistance.
7.13. learner calculates, using Ohm's, Watt's, and Kirchoff's Laws, all electrical quantities throughout a three-resistor combination series - parallel resistive circuit.
7.14. learner measures values in combinatorial series - parallel circuits to verify theoretical values.

Learning Objectives

7.a. Identify three types of electrical circuit configurations.
7.b. Discuss the characteristics of various circuit configurations.
7.c. Apply Ohm's Law and Watt's Law to obtain unknown values in different circuit configurations.
7.d. Build three configurations of electrical circuits.
7.e. Perform circuit measurements to verify predicted values.

8. Investigate sources of DC electrical power.

Domain *Cognitive* ***Level*** *Analyzing* ***Status*** *Active*

Linked Core Abilities

Demonstrate ability to think critically.
Make decisions that incorporate the importance of sustainability.
Transfer social and natural science theories into practical applications.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.

Assessment Strategies

8.1. Written Objective Test

Criteria

Performance will be satisfactory when:

8.1. learner passes a written objective test with a score of 75% or above.
8.2. learner explains various types of battery technology.
8.3. learner analyzes the results of series and parallel battery connections.
8.4. learner correctly explains the basic operation of solar cells, thermocouples and piezoelectric devices.

Learning Objectives

8.a. Discuss various types of battery technology.
8.b. Analyze the results of series and parallel battery connections.
8.c. Discuss the basic operation of solar cells.
8.d. Examine the operation of thermocouples.
8.e. Investigate the function of piezoelectric DC sources.
8.f. Introduce the conversion of AC to DC electrical power.

9. Explore the relationship between electricity and magnetism.

Domain *Cognitive* ***Level*** *Applying* ***Status*** *Active*

Linked Core Abilities

Demonstrate ability to think critically.

Transfer social and natural science theories into practical applications.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

9.1. Written Objective Test
9.2. Skill Demonstration

Criteria

Performance will be satisfactory when:

9.1. learner passes a written objective test with a score of 75% or above.
9.2. learner passes a performance skill test with a score of 75% or above.
9.3. learner properly explains magnetic attraction and repulsion.
9.4. learner compares the magnetic fields of permanent and electromagnets.
9.5. learner properly explains generator and motor action.
9.6. learner properly constructs directed relay control circuits.
9.7. learner tests a relay for pull-in and drop-out voltage and current.

Learning Objectives

9.a. Examine the characteristics of the magnetic fields surrounding permanent and electromagnets.
9.b. Discuss magnetic attraction and repulsion.
9.c. List the most common electromagnetic devices encountered in electrical applications.
9.d. Discuss how a "clamp on" meter measures current.
9.e. Examine the fundamental concepts of generator and motor action.
9.f. Identify a relay by electrical characteristics and contact type.
9.g. Measure pull-in and drop-out values of voltage and current for a specified relay.
9.h. Construct and test basic relay control circuits.

10. Investigate the basic DC operation of inductors and capacitors.

Domain *Cognitive* ***Level*** *Analyzing* ***Status*** *Active*

Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

10.1. Written Objective Test

Criteria

Performance will be satisfactory when:

10.1. learner passes a written objective test with a score of 75% or above.
10.2. learner explains inductance.
10.3. learner relates the principles for electromagnetism to inductors.
10.4. learner calculates total inductive values in series and parallel inductors circuits.
10.5. learner describes the initial instantaneous condition for the application of DC to a resistor - inductor circuit model, then compares this condition to the circuit after five time constants.

10.6. learner describes plate area and separation as they relate to capacitance.
10.7. learner lists common failures in capacitors based on type and style.
10.8. capacitors are measured for comparison to their tolerance standards.
10.9. capacitors are arranged in series and parallel configurations to measure total capacitance and compare with calculated values.
10.10. learner explains the DC blocking ability of a capacitor.
10.11. learner describes the initial instantaneous condition for the application of DC to a discharged capacitor, correlating the condition to a fully charged capacitor.

Learning Objectives

10.a. Describe the electromagnetic field storage ability of an inductor.
10.b. Use measuring instruments to compare nominal with actual inductance values.
10.c. Describe several inductor applications.
10.d. Investigate the L/R Time constant characteristics for a series RL circuit.
10.e. Describe the electrostatic field storage ability of a capacitor.
10.f. Discuss capacitors in terms of type, tolerance, polarities and labeling methods.
10.g. Measure capacitance values using proper test equipment.
10.h. Calculate and measure total capacitive values of combination series and parallel capacitors.
10.i. Describe several capacitor applications.
10.j. Investigate the RC Time constant characteristics for a series RC circuit.

11. Examine the characteristics of an AC voltage source.

Domain *Cognitive* ***Level*** *Analyzing* ***Status*** *Active*

Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Make decisions that incorporate the importance of sustainability.
Transfer social and natural science theories into practical applications.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

11.1. Written Objective Test
11.2. Skill Demonstration

Criteria

Performance will be satisfactory when:

11.1. learner passes a written objective test with a score of 75% or above.
11.2. learner passes a skill performance test with a score of 75% or above.
11.3. learner describes the process of AC generation.
11.4. learner explains the difference between an AC sinusoid and an equivalent steady state DC source for a period of time.
11.5. learner converts a sinusoid period to its equivalent frequency.
11.6. learner converts the frequency of a sinusoid to its equivalent period.
11.7. learner labels a sine wave at its peak amplitude and zero crossings for one cycle, with the related degree representations.
11.8. learner calculates peak and rms values from sine wave peak-to-peak values.
11.9. learner calculates peak-to-peak values from peak and rms values for sine waves.
11.10. learner identifies the hot, neutral and ground connections on the front face of the AC outlet.
11.11. learner lists the terminal screw colors for the hot, neutral and ground connections of an AC outlet.
11.12. learner lists the expected voltage readings between connections of a standard 120VAC outlet.
11.13. learner verifies predicted AC values with a digital multimeter and an ocscilloscope or scopemeter.

Learning Objectives

11.a. Investigate the generation of AC power.
11.b. Calculate the relationship between frequency and period for a complete AC cycle.
11.c. Compare a sinusoidal waveform to a circle in degrees.
11.d. Convert values between peak, peak to peak and RMS for sine wave voltages.
11.e. Relate the effective value of an AC voltage source to an equivalent DC voltage source.
11.f. List the names of the three connections of a single phase AC outlet.
11.g. List the terminal screw colors for the hot, neutral and ground connections of an AC outlet.
11.h. Identify the hot, neutral and ground connections on the front face of the AC outlet.
11.i. List the expected voltage readings between connections of a standard 120VAC outlet.
11.j. Verify predicted AC values with a digital multimeter and an ocscilloscope or scopemeter.

12. Explore the characteristics of a single phase transformer.

Domain *Cognitive* ***Level*** *Analyzing* ***Status*** *Active*

Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

12.1. Written Objective Test
12.2. Skill Demonstration

Criteria

Performance will be satisfactory when:

12.1. learner passes a written objective test with a score of 75% or above.
12.2. learner passes a performance test with a score of 75% or above.
12.3. learner explains transformer characteristics including isolation and phase relationships.
12.4. learner calculates the turns ratios of both step-up and step-down transformers.
12.5. learner describes basic transformer action from the primary to secondary windings.
12.6. learner defines losses that affect efficiency of transformers.
12.7. learner utilizes appropriate instrumentation for transformer circuit measurement to verify predicted values.

Learning Objectives

12.a. Describe basic transformer action from the primary to secondary windings.
12.b. Discuss transformer characteristics including isolation and phase relationships.
12.c. Define losses that affect efficiency of transformers.
12.d. Calculate the turns ratios of both step-up and step-down transformers.
12.e. Utilize appropriate instrumentation for transformer circuit measurement.

13. Compare single phase and three phase power systems.

Domain *Cognitive* ***Level*** *Applying* ***Status*** *Active*

Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Make decisions that incorporate the importance of sustainability.
Transfer social and natural science theories into practical applications.
Use effective communication skills.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.

Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

13.1. Written Objective Test

Criteria

Performance will be satisfactory when:

13.1. learner passes a written objective test with a score of 75% or above.
13.2. learner determines the angular relationship between the three phases of a three phase power system.
13.3. learner explains the basic Wye and Delta configurations of three phase circuits.
13.4. learner lists three reasons why three phase power is superior to single phase.
13.5. learner calculates the phase voltage in balanced three phase wye and delta circuits based on a given line voltage.
13.6. learner calculates the line voltage in balanced three phase wye and delta circuits base on a given phase voltage.
13.7. learner calculates the phase current in balanced three phase wye and delta circuits based on a given line current.
13.8. learner calculates the line current in balanced three phase wye and delta circuits based on a given phase current.
13.9. learner calculates individual voltage, current and power values for resistive loads in balanced three phase wye and delta circuits base on given parameters.
13.10. learner calculates the total three phase power for resistive loads in balanced three phase wye and delta circuits base on given parameters.

Learning Objectives

13.a. Examine the benefits of three phase power over single phase.
13.b. Discuss the basic principles of three phase power generation.
13.c. Perform oscilloscope measurements to verify predicted angular relationship of each phase in a three phase system.
13.d. Investigate the basic Wye and Delta configurations of three phase circuits.
13.e. Discuss the terms "phase" and "line" as related to three phase power systems.
13.f. Explore the mathematical relationships between phase voltage and line voltage in Wye and Delta configurations.
13.g. Explore the mathematical relationships between phase current and line current in Wye and Delta configurations.
13.h. Calculate electrical quantity values for resistive loads in balanced three phase wye and delta circuits.
13.i. Measure voltage and current values in Wye and Delta three phase circuits to verify predicted values.

14. Examine AC circuits containing resistance, inductance and capacitance.

Domain *Cognitive* ***Level*** *Analyzing* ***Status*** *Active*

Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Use effective communication skills.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

14.1. Written Objective Test

Criteria

Performance will be satisfactory when:

14.1. learner passes a written objective test with a score of 75% or above.
14.2. learner defines inductive reactance, states its units and indicates its symbol in electrical equations.
14.3. learner calculates inductive reactance of an inductor based on given values of inductance and source frequency..
14.4. learner describes the phase shift between voltage and current in an inductive circuit.
14.5. learner calculates impedance for AC combination series and parallel RL circuits.
14.6. learner calculates all values of voltage, current and impedance in series and parallel RL circuits with AC sources.
14.7. learner defines capacitive reactance, states its units and indicates its symbol in electrical equations.
14.8. learner calculates capacitive reactance of a capacitor based on given values of capacitance and source frequency.
14.9. learner describes the phase shift between voltage and current caused by a capacitor in an AC circuit.
14.10. learner determine impedance for AC combination series and parallel RC circuits.
14.11. learner calculates all values of voltage, current and impedance in series and parallel RC circuits with AC sources.
14.12. learner describes how inductor and capacitor phase shift properties are utilized in the starting operation of a single phase motor.

Learning Objectives

14.a. Explore the operating characteristics of inductors and capacitors in an AC circuit.
14.b. Discuss why inductors and capacitors cause a phase shift between voltage and current in AC circuits.
14.c. Define inductive reactance and capacitive reactance and indicate their symbols in electrical equations.
14.d. Calculate inductive reactance and capacitive reactance.
14.e. Investigate the affect of changing the source frequency on values of inductive and capacitive reactance.
14.f. Define and calculate impedance in an AC inductive or capacitive circuit.
14.g. Apply Ohm's Law to capacitive and inductive AC circuits.
14.h. Utilize appropriate instrumentation for RC and RL circuit measurement to verify predicted values.
14.i. Discuss inductor and capacitor phase shift properties related to the starting operation of a single phase motor.

15. Investigate RLC Circuit applications and power factor.

Domain *Cognitive* ***Level*** *Applying* ***Status*** *Active*

Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Make decisions that incorporate the importance of sustainability.
Transfer social and natural science theories into practical applications.
Use effective communication skills.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

15.1. Written Objective Test

Criteria

Performance will be satisfactory when:

15.1. learner passes a written objective test with a score of 75% or above.
15.2. learner defines, states the units and indicates the proper symbol for true, reactive and apparent power.
15.3. learner calculates true, reactive and apparent power in combination RLC circuits.
15.4. learner defines power factor and explains its significance relative to energy cost.
15.5. learner describes methods of power factor correction.

15.6. learner applies Ohm's Law to AC series and parallel RLC circuits.
15.7. learner defines resonance and describes the properties of a resonant RLC circuit.
15.8. learner describes applications of resonant series and parallel RLC circuits.
15.9. learner identifies high pass, low pass and band pass filter circuits and their applications.

Learning Objectives

15.a. Discuss the relationships between True Power, Reactive Power and Apparent Power in inductive, capacitive, resistive and combination AC circuits.
15.b. Apply Ohm's Law to calculate all electrical quantity values in AC RLC circuits.
15.c. Define power factor and discuss its significance relative to the inductive loads in an industrial environment.
15.d. Examine the costs of a poor power factor and investigate methods of power factor correction.
15.e. Investigate the resonant condition when the capacitive and inductive reactances are equal in series and parallel RLC circuits.
15.f. Discuss applications of resonant series and parallel RLC circuits.
15.g. Utilize appropriate instrumentation for RLC circuit measurement.
15.h. Discuss RC, RL and RLC filter circuit applications.

16. Troubleshoot electrical circuits.

Domain *Psychomotor* ***Level*** *Practicing* ***Status*** *Active*

Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Demonstrate ability to value self and work ethically with others in a diverse population.
Make decisions that incorporate the importance of sustainability.
Transfer social and natural science theories into practical applications.
Use effective communication skills.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Perform preventative maintenance.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

16.1. Written Objective Test
16.2. Skill Demonstration

Criteria

Performance will be satisfactory when:

16.1. learner passes a written objective test with a score of 75% or above.
16.2. learner passes a skill performance test with a score of 75% or above.
16.3. learner develops an effective troubleshooting strategy.
16.4. learner determines appropriate test equipment for circuit troubleshooting
16.5. learner identifies potential problems introduced in a circuit by measuring instruments.
16.6. learner identifies circuit conditions that would occur as a result shorts and opens in series and parallel circuits.
16.7. learner performs appropriate circuit measurements to determine the circuit fault.
16.8. learner repairs faulty electrical circuits.

Learning Objectives

16.a. Develop an effective troubleshooting strategy.
16.b. Determine appropriate test equipment for circuit troubleshooting
16.c. Discuss potential problems introduced in a circuit by measuring instruments.
16.d. List circuit conditions that would occur as a result of a short in a series circuit.
16.e. List circuit conditions that would occur as a result of a short in a parallel circuit.
16.f. List circuit conditions that would occur as a result of an open in a series circuit.

16.g. List circuit conditions that would occur as a result of an open in a parallel circuit.
16.h. Discuss expected circuit properties when the problem is neither a short or open.
16.i. Perform appropriate circuit measurements to determine the circuit fault.