



Lakeshore Technical College

10-620-122 Industrial Wiring

Course Outcome Summary

Course Information

Alternate Title	formerly Industrial Controls Introduction
Description	Introduces the student to procedures required while working with electrical circuits to maintain a safe work environment. Stressing compliance with electrical codes for the installation, maintenance and troubleshooting of electrical circuits and systems. The student will construct, test, and analyze typical industrial electrical control circuits.
Total Credits	2
Total Hours	54

Types of Instruction

Instruction Type	Credits/Hours
Laboratory	36 hours
Lecture	18 hours

Textbooks

Gary Rockis, Glen Mazur. *Electrical Motor Controls for Integrated Systems. Edition 5* American Technical Publishers. 2013 ISBN# 978-0-8269-1217-6. (Bookstore)

Gary Rockis, Glen Mazur. *Electrical Motor Controls for Integrated Systems. Edition 5 Workbook* American Technical Publishers. 2013 ISBN# 978-0-8269-1227-5. (Bookstore)

Learner Supplies

Calculator

Notebook

Core Abilities

1. Apply learning

Criteria

- 1.1. Learner transfers academic knowledge and principles to life and work situations
- 1.2. Learner incorporates prior learning
- 1.3. Learner knows when to ask for help
- 1.4. Learner demonstrates appropriate safety precautions

- 1.5. Learner identifies the need for lifelong learning
- 1.6. Learner develops the ability to research beyond the required work
- 1.7. Learner demonstrates a curiosity for learning about cultures, norms, and practices

2. Apply sustainable practices

Criteria

- 2.1. Learner demonstrates awareness of the ecological impact related to his/her chosen area of study
- 2.2. Learner identifies environmental conservation strategies
- 2.3. Learner can identify how sustainable practices produce a lean work environment
- 2.4. Learner incorporates sustainable practices (environmental, economic, social, and cultural) during the decision making process

3. Communicate effectively

Criteria

- 3.1. Learner comprehends written materials
- 3.2. Learner writes clearly, concisely, and accurately
- 3.3. Learner adjusts communication style in order to meet the needs of others
- 3.4. Learner demonstrates active listening skills
- 3.5. Learner uses culturally appropriate verbal and non-verbal communication methods

4. Demonstrate critical thinking

Criteria

- 4.1. Learner determines issues that merit action
- 4.2. Learner takes initiative in the problem solving processes
- 4.3. Learner makes decisions considering alternatives and consequences
- 4.4. Learner refines action plans based on evaluation of feedback
- 4.5. Learner identifies interdependencies of world issues & events

5. Demonstrate responsible and professional workplace behaviors

Criteria

- 5.1. Learner displays behavior consistent with the ethical standards within a discipline or profession
- 5.2. Learner follows policies and procedures
- 5.3. Learner attends class as mandated by the instructor
- 5.4. Learner completes assignments on time
- 5.5. Learner exhibits academic honesty
- 5.6. Learner accepts responsibility and accountability for his/her actions
- 5.7. Learner demonstrates time management and task prioritization
- 5.8. Learner demonstrates ability to handle ambiguity and unfamiliar situations

6. Integrate technology

Criteria

- 6.1. Learner determines which tasks can be performed more efficiently by using technology
- 6.2. Learner uses technology to perform tasks more efficiently
- 6.3. Learner adapts to changing/emerging technology
- 6.4. Learner selects culturally appropriate technology/tools to communicate with diverse groups

7. Respect and appreciate diversity

Criteria

- 7.1. Learner demonstrates respectful workplace actions for successfully working with a diverse workforce (race, color, creed, national origin, religion, age, sex, sexual orientation, disability, and other differences).
- 7.2. Learner observes business customs/etiquette, time zone differences, and holidays
- 7.3. Learner identifies own bias and can adapt to the customs and practices of others
- 7.4. Learner demonstrates respectful behavior for living/working in a diverse society

8. Use mathematics effectively

Criteria

- 8.1. Learner solves real world problems using mathematics
- 8.2. Learner measures accurately
- 8.3. Learner analyzes graphical information

8.4. Learner demonstrates an understanding of world measurements and foreign currency exchange

9. **Work cooperatively**

Criteria

- 9.1. Learner contributes to a group with ideas, suggestions, and effort
- 9.2. Learner completes his/her share of tasks necessary to complete a project
- 9.3. Learner encourages team members by listening and responding appropriately to their contributions
- 9.4. Learner maintains self control
- 9.5. Learner resolves differences for the benefit of the team
- 9.6. Learner accepts constructive feedback
- 9.7. Learner effectively establishes rapport and builds situationally appropriate relationships

Program Outcomes

1. **Perform work safely**

Criteria

- 1.1. Follow Lock-out Tag-out safety procedures and practices to ensure proper start-up and shutdown of equipment
- 1.2. Follow Personal Protective Equipment requirement
- 1.3. Follow established safety policies and practices (e.g. OSHA, site specific)

2. **Troubleshoot electrical and mechanical systems and devices**

Criteria

- 2.1. Verify proper operation or problem
- 2.2. Identify the cause of the problem; mechanical, electrical
- 2.3. Determine corrective action
- 2.4. Utilize appropriate test equipment

3. **Communicate technical information**

Criteria

- 3.1. Interpret documentation or electro-mechanical devices and systems
- 3.2. Use field specific technical terminology in speaking and writing
- 3.3. Create electro-mechanical diagrams
- 3.4. Document problems and solutions
- 3.5. Interpret electro-mechanical diagrams

4. **Integrate electrical and mechanical systems and devices**

Criteria

- 4.1. Identify required communication protocols
- 4.2. Configure electronic equipment for data communication compatibility
- 4.3. Configure sensors, controls and actuators for system compatibility
- 4.4. Install required communications infrastructure
- 4.5. Verify communications between systems and devices

Course Competencies

1. **Apply Ohm's Law**

Linked Core Abilities

Use mathematics effectively

Linked Program Outcomes

Perform work safely

Assessment Strategies

- 1.1. Written Objective Test
- 1.2. Skill Demonstration

Criteria

Performance will be satisfactory when:

- 1.1. Complete written test with a score of 75% or better
- 1.2. In a lab environment
- 1.3. Satisfactory completion of skill demonstration

Learning Objectives

- 1.a. Review Ohm's Law
- 1.b. Calculate circuit resistance
- 1.c. Calculate circuit current
- 1.d. Calculate circuit voltage
- 1.e. Test an electric circuit with a digital multimeter for resistance
- 1.f. Test an electric circuit with a digital multimeter for current
- 1.g. Test an electric circuit with a digital multimeter for voltage

2. Define the 5 components of an electrical circuit

Linked Core Abilities

Apply learning
Demonstrate critical thinking
Integrate technology

Linked Program Outcomes

Troubleshoot electrical and mechanical systems and devices

Assessment Strategies

- 2.1. Written Objective Test
- 2.2. Skill Demonstration

Criteria

Performance will be satisfactory when:

- 2.1. Complete written test with a score of 75% or better
- 2.2. In a lab environment
- 2.3. Satisfactory completion of skill demonstration

Learning Objectives

- 2.a. Define conductors
- 2.b. Define insulators
- 2.c. Define semiconductors
- 2.d. Use Ohms Law to determine unknown voltage
- 2.e. Use Ohms Law to determine current
- 2.f. Use Ohms Law to determine resistance
- 2.g. Determine how inductance influences an AC circuit
- 2.h. Determine how capacitance influences an AC circuit
- 2.i. How circuits can be safely tested using various types of meters.

3. Apply electrical safety practices such as LOTO and ARC Flash protection, wearing appropriate PPE

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Integrate technology

Linked Program Outcomes

Perform work safely
Troubleshoot electrical and mechanical systems and devices
Integrate electrical and mechanical systems and devices

Assessment Strategies

- 3.1. Written Objective Test
- 3.2. Skill Demonstration

Criteria

Performance will be satisfactory when:

- 3.1. Complete written test with a 75% or better
- 3.2. Demonstrate proper work practices using appropriate PPE

Learning Objectives

- 3.a. Demonstrate proper use of personal protective equipment used by the electrical trades
- 3.b. Demonstrate safe work practices
- 3.c. Examine the NEC codebook
- 3.d. Examine the NFP70E, the ARC flash handbook

4. Define the different types of measurements a digital multimeter is used for

Linked Core Abilities

Apply learning
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Integrate technology
Use mathematics effectively

Linked Program Outcomes

Troubleshoot electrical and mechanical systems and devices

Assessment Strategies

- 4.1. Written Objective Test
- 4.2. Skill Demonstration

Criteria

Performance will be satisfactory when:

- 4.1. you complete written test with a 75% or better
- 4.2. you demonstrate the correct meter usage for measuring resistance, voltage, and current using the appropriate meter.

Learning Objectives

- 4.a. Examine various types of electrical meters
- 4.b. Explore using a meter to measure resistance
- 4.c. Explore using a meter to measure voltage
- 4.d. Explore using a meter to measure amperage
- 4.e. Understand how to interpret meter readings

5. Use a digital multimeter to safely test electrical circuits

Assessment Strategies

- 5.1. Skill Demonstration

Criteria

Performance will be satisfactory when:

- 5.1. In a lab environment
- 5.2. Satisfactory completion of skill demonstration

Learning Objectives

- 5.a. Demonstrate how to conduct an insulation check on a motor and electrical conductors
- 5.b. Demonstrate making appropriate connections to meter to test for resistance
- 5.c. Demonstrate making appropriate connections to meter to test for current
- 5.d. Demonstrate making appropriate connections to meter to test for voltage
- 5.e. Test the circuit for resistance
- 5.f. Test the circuit for current
- 5.g. Test the circuit for voltage
- 5.h. Test circuits using an AMP clamp
- 5.i. Test circuits for insulation integrity

6. Identify wire color codes and NEC requirements for electrical installations

Linked Core Abilities

Apply learning
Demonstrate responsible and professional workplace behaviors
Integrate technology
Respect and appreciate diversity
Work cooperatively

Linked Program Outcomes

Perform work safely

Assessment Strategies

6.1. Written Objective Test

Criteria

Performance will be satisfactory when:

6.1. Complete written test with a 75% or better

Learning Objectives

- 6.a. Examine various types of conductors used in electrical circuits
- 6.b. Define what types of insulation are used in the construction of wire and what the color indicates
- 6.c. Use the NEC code book to size wire for an installation
- 6.d. Identify meaning and use of color designations per the NEC code
- 6.e. Understand the importance of following NEC code requirements

7. Terminate wires to the correct torque specifications

Assessment Strategies

- 7.1. Written Objective Test
- 7.2. Skill Demonstration

Criteria

Performance will be satisfactory when:

- 7.1. Complete written test with a score of 75% or better
- 7.2. In a lab environment
- 7.3. Satisfactory completion of a skill demonstration

Learning Objectives

- 7.a. Define the importance proper torque application
- 7.b. Properly set up the torque wrench/screwdriver
- 7.c. Use appropriate wire for installation
- 7.d. Correctly strip wire
- 7.e. Correctly torque wire terminations per manufacturers specifications

8. Define various input devices used for motor control.

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Integrate technology
Use mathematics effectively

Linked Program Outcomes

Troubleshoot electrical and mechanical systems and devices

Assessment Strategies

8.1. Written Objective Test

Criteria

You will know you are successful when:

8.1. you complete written test with a score of 75% or better

Learning Objectives

- 8.a. Identify normally open and normally closed contacts of a device
- 8.b. Define manual or automatic devices
- 8.c. Apply appropriate control device for the application

9. Define mechanical relays and solenoids.

Linked Core Abilities

Apply learning
Demonstrate critical thinking
Integrate technology

Linked Program Outcomes

Troubleshoot electrical and mechanical systems and devices

Assessment Strategies

- 9.1. Written Objective Test

Criteria

You will know you are successful when:

- 9.1. you complete written test with score of 75% or better

Learning Objectives

- 9.a. Demonstrate the functions of solenoids and how they are utilized for circuit control
- 9.b. Demonstrate the functions of relays and how they are utilized for circuit control
- 9.c. Demonstrate construction and operation of these components and their limitations

10. Apply correct installation procedures for motor control systems per NEC code.

Linked Core Abilities

Apply learning
Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Integrate technology
Respect and appreciate diversity
Use mathematics effectively
Work cooperatively

Linked Program Outcomes

Perform work safely
Communicate technical information
Integrate electrical and mechanical systems and devices

Assessment Strategies

- 10.1. Written Objective Test
- 10.2. Skill Demonstration

Criteria

You will know you are successful when:

- 10.1. you complete written test with a 75% or better
- 10.2. you complete the lab activity

Learning Objectives

- 10.a. Examine various output devices used to control a process
- 10.b. Demonstrate the functions of solenoids and how they are utilized for circuit control
- 10.c. Demonstrate the functions of relays and how they are utilized for circuit control
- 10.d. Demonstrate construction and operation of these components and their limitations

11. Define the different types of controls and components used in industrial installations.

Linked Core Abilities

Apply learning

Communicate effectively
Demonstrate critical thinking
Demonstrate responsible and professional workplace behaviors
Integrate technology
Respect and appreciate diversity
Work cooperatively

Linked Program Outcomes

Troubleshoot electrical and mechanical systems and devices
Integrate electrical and mechanical systems and devices

Assessment Strategies

11.1. Written Objective Test

Criteria

11.1. Complete written test with a 75% or better

Learning Objectives

11.a. Examine various mechanical devices used in electrical installations
11.b. Demonstrate how the functions of different components are utilized for circuit control
11.c. Demonstrate construction and operation of various components and their limitations

12. Use basic electrical symbols and follow the rules of wiring diagrams.

Linked Core Abilities

Apply learning
Integrate technology
Respect and appreciate diversity
Use mathematics effectively
Work cooperatively

Linked Program Outcomes

Troubleshoot electrical and mechanical systems and devices
Communicate technical information
Integrate electrical and mechanical systems and devices

Assessment Strategies

12.1. Written Objective Test

Criteria

12.1. Complete written test with a 75% or better

Learning Objectives

12.a. Examine various symbols used to identify electrical components
12.b. Understand how the symbols are used with various types of diagrams to illustrate electrical circuits
12.c. Demonstrate how to read an electrical diagram
12.d. Understand an electrical diagrams control logic
12.e. Demonstrate how to modify a circuit and correctly update the diagram

13. Illustrate and wire 2 wire and 3 wire motor control circuits.

Linked Core Abilities

Apply learning
Demonstrate critical thinking
Integrate technology
Use mathematics effectively
Work cooperatively

Linked Program Outcomes

Troubleshoot electrical and mechanical systems and devices
Communicate technical information
Integrate electrical and mechanical systems and devices

Assessment Strategies

13.1. Written Objective Test

Criteria

13.1. Complete written test with a 75% or better

Learning Objectives

- 13.a. Use various symbols used to illustrate 2 wire control electrical components
- 13.b. Use various symbols used to illustrate 3 wire control electrical components
- 13.c. Demonstrate how to modify a circuit and correctly update the diagram
- 13.d. Understand the construction and operation of a solenoid, relay, contactor, and a motor starter.
- 13.e. Learn the functions of relays and how they are utilized for circuit control.
- 13.f. Learn the difference between a contactor and a motor starter.
- 13.g. How to wire a control circuit using these devices.
- 13.h. Learn what inrush current and seal in current is and how it affects a circuit.
- 13.i. Learn what pick up voltage, seal in voltage and drop out voltage is in relation to a solenoid