

# ISET-2200: INDUSTRIAL MOTOR CONTROLS

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## Cuyahoga Community College

**Viewing: ISET-2200 : Industrial Motor Controls**

**Board of Trustees:**

March 2021

**Academic Term:**

Fall 2021

**Subject Code**

ISET - Integrated Systems Engineering

**Course Number:**

2200

**Title:**

Industrial Motor Controls

**Catalog Description:**

Instruction in theory, application, and use of industrial type motors focusing on topics of safety, direct current (DC) motors, alternating current (AC) motors, single-phase motors, three-phase motors, motor troubleshooting methods, and motor starting. Extensive guided instruction and practice provided.

**Credit Hour(s):**

3

**Lecture Hour(s):**

2

**Lab Hour(s):**

2

## Requisites

**Prerequisite and Corequisite**

ISET-1420 Applied Electricity II, or EET-1210 AC Electric Circuits, or EET-1220 Circuits and Electronics for Automation, or departmental approval.

## Outcomes

**Course Outcome(s):**

Identify and apply proper safety standards according to the National Electrical Code (NEC) and OSHA.

**Objective(s):**

1. Apply lockout/tagout procedures.
2. List OSHA standards for safe motor installation, repair, and maintenance.
3. Recognize NEC articles referring to motors, controls, and installations.

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**Course Outcome(s):**

Install and repair electric motor drives.

**Objective(s):**

1. Identify the different motor drive configurations and applications.
2. List the benefits of motor drives.
3. Discuss solid state switching and related devices.
4. Illustrate different sine waves.
5. Explain Pulse Width Modulation (PWM).

6. Discuss electric motor drive programming.
7. Apply troubleshooting procedures for motor drives.

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**Course Outcome(s):**

Install and repair control systems for DC and AC motors.

**Objective(s):**

1. Differentiate between the different AC motor configurations.
2. Identify split phase motors.
3. Explain phase relationships in split phase single phase motors.
4. Explain starting methods for AC motors.
5. Discuss speed control for AC motors.
6. Identify National Electrical Code standards for installation and overload protection of motors.
7. Calculate motor installation, application, and load requirements.
8. Apply troubleshooting procedure for AC single and three phase motors.
9. Explain the fundamentals of motor control circuits and hardware.
10. Explain the use of motor starter contactors.
11. Identify motor control hardware and controls.
12. Explain the difference between two and three wire controls.
13. Recognize wiring components (seal in circuit, auxiliary contacts, interlocking).
14. Identify relay logic.
15. Sketch relay logic diagrams.
16. Apply proper hardware for control applications.
17. Demonstrate wiring techniques for motor controls circuits using motor starters.
18. Apply troubleshooting procedures for motor controls.
19. Explain the fundamentals of DC and AC motor operations.
20. Identify the properties of series, shunt, compound and permanent magnet motors.
21. Explain starting methods for DC motors.
22. Recognize speed controls of DC motors.
23. Apply troubleshooting procedure for DC motors.
24. Identify the properties of AC induction type motors single and three phase.

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**Methods of Evaluation:**

1. Completion of homework assignment
2. Written and verbal quizzes covering homework and in class demonstrations
3. Demonstration of application of theories and methods
4. Final exam

**Course Content Outline:**

1. Concepts
  - a. Matter (electrons)
  - b. Ohm's Law
  - c. Operating principles of direct and alternating current motors (single and three phase)
  - d. American Wire Gauge (AWG)
  - e. Conductors
  - f. Load calculations
  - g. Principles of motor control circuits and techniques
  - h. Relay logic
    - i. Principles of motor controls
    - j. Two and three wire controls
  - k. Overcurrent protection
    - l. Motor control hardware and components
- m. Kirchhoff's Voltage Law
- n. Kirchhoff's Current Law
- o. DC Basics

- p. AC Basics
  - q. Electric motors (AC/DC)
    - r. Transformers
    - s. Meters
    - t. National Electric Code standards and regulations
  - u. OSHA safety standards
    - v. Grounding
  - w. Flowcharting
  - x. Troubleshooting
    - y. Electric motor nomenclature
    - z. Tooling components
  - aa. Raceways
  - bb. Measurement systems (U.S. Customary and Metric)
2. Skills
- a. Calculate motor loads
  - b. Relay logic diagrams
  - c. Install, maintain, troubleshoot control circuitry wiring
  - d. Reading instrumentation (meters)
  - e. Troubleshooting (fundamentals)
  - f. Recognizing industrial conditions for proper applications
  - g. Interpret local electrical regulations for installations
  - h. Creating troubleshooting flow charts
    - i. Estimating installation and repair time
    - j. Apply safety rules and regulations
  - k. Provide quality customer service
    - l. Interpreting schematics and drawings
  - m. Interpreting National Electric Code (NEC)
  - n. Locating additional resources for materials & troubleshooting
  - o. Interpreting drawings and schematics that are dimensioned in U.S. customary and metric units
  - p. Identifying measuring and hand tools for specific jobs
  - q. Discussing proper fastening techniques
    - r. Installing control systems for DC/AC motors (relays, motor starters, overload protection)
  - s. Installing electric motor drives
    - t. Follow maintenance procedures
3. Issues
- a. Hardware manufacturers and distributors
  - b. Networking
  - c. Safe installations
  - d. Design for future growth
  - e. Taking concept and applying it
  - f. Troubleshooting
  - g. Inability to identify problem

## Resources

Herman, Stephen L. *Delmar's Standard Textbook of Electricity*. 7th ed. Cengage Learning, 2019.

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Herman, Stephen L. *Electric Motor Control*. 10th ed. Cengage Learning, 2014.

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Herman, Stephen L. *Electrical Transformers and Rotating Machines*. 4th ed. Cengage Learning, 2016.

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Holt, Mike. *Understanding Basic Motor Controls*. Mike Holt Enterprises, 2017.

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Rockis, Gary and Glen A. Mazur. *Electrical Motor Controls for Integrated Systems*. 5th ed. American Technical Publishers, 2014.

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