

# APEL 126: MOTORS; MOTOR CONTROL; LIGHTING PROTECTION

## Foothill College Course Outline of Record

Heading	Value
<b>Effective Term:</b>	Summer 2021
<b>Units:</b>	4
<b>Hours:</b>	24 lecture, 72 laboratory per quarter (96 total per quarter)
<b>Prerequisite:</b>	Per California Code of Regulations, this course is limited to students admitted to the Electrical Apprenticeship Program.
<b>Advisory:</b>	Not open to students with credit in APRT 126.
<b>Degree &amp; Credit Status:</b>	Degree-Applicable Credit Course
<b>Foothill GE:</b>	Non-GE
<b>Transferable:</b>	None
<b>Grade Type:</b>	Letter Grade (Request for Pass/No Pass)
<b>Repeatability:</b>	Not Repeatable

## Student Learning Outcomes

- A successful student will be able to identify motor controls symbols.
- A student will be able to explain line and wiring diagram construction of motor control circuits.
- A student will be able to explain the logic of control circuits.
- A student will be able to introduce manual and automatic motor control fundamentals using relays, contactors, magnetic motor starters and control components.
- A student will be able to explain the practical applications of motor controls with AC and DC motors and how they are used for control commercial and industrial equipment.
- A student will be able to work on or around mechanical and electrical equipment.
- A successful student will be able to identify lock out/tag out procedures.
- A successful student will be able demonstrate use of person protective equipment.

## Description

A study of different motor types and controls with emphasis on protecting the motors and the buildings they are in with lightning protection systems. Reading and interpretation of schematic drawings.

## Course Objectives

The student will be able to:

- Compare different types of motors, their construction and usage.
- Discuss motor controls.
- Explain and read schematic drawings.
- Design and install building lightning protection systems.

## Course Content

- Motors and their construction
  - Function, operation and characteristics of various types of motors (AC, DC, dual voltage repulsion, universal, 3 phase, squirrel cage, synchronous)
  - Physical parts of various motors
  - Utilize information sheets, plans, schematics, and motor nameplates to gain information
  - Motor losses
  - Starting and operating characteristics
  - Methods to identify windings in DC motor
  - Means for providing field failure, current limit, voltage and speed control
  - Block diagrams to demonstrate power supplies, armature, field and control features
  - Torque, locked rotor current, no-load speed, and slip
  - Reasons for low voltage starting
  - Function, operation and characteristics of stepping motors
  - Proper techniques for motor installations
  - Necessary calculations for electrical requirements per code
  - Correct power factor
  - Proper wire type and size
  - Appropriate connections
  - How various motors can be made to run at a different speed or direction
  - Schematics
  - Connections top reverse or change direction
- Function, operation and characteristics of motor controllers, circuits and devices
  - Ways and means of starting and stopping motors
  - Operation of a magnetic coil
  - Use of magnetic starters and controllers
  - Correct sizing of magnetic starters and controllers
  - Difference between starters and contactors
  - Function, operation, and characteristics of overload protective devices
  - Schematics for various control circuits
  - Two-wire control
  - Three-wire control circuits
  - Interlocking methods
  - Reversing and sequential controllers
  - Jogging, inching, plugging
  - Multiple start-stop controls and selector switches
  - Phase failure relays
  - Various manual and automatic speed control techniques
  - Function, operation, and characteristics of variable frequency drive systems
  - Function, operation, characteristics and installation procedures, programmable logic controllers
  - Ladder diagrams
  - Function, operation, and characteristics of timers, counters, sequencers
  - Utilize appropriate manual and information for start-up, maintenance and testing
  - Utilize schematics for manual starters, automatic starters, speed regulators, and controllers
- Reading motor control drawings
  - Two-wire control circuits
  - Three-wire motor control
  - Controls application
  - Pushbutton interlocks
  - Mechanical interlocks

6. Jogging and plugging controls
7. DC and AC applications
8. Schematic including switches and relays
9. Function, operation and characteristics of electronic sensor and pilot devices
10. Function, operation and characteristics of control transformers
- D. Lighting protection systems
1. Introduction to lightning protection systems
2. Designing lightning protection systems
3. Installing lightning protection systems

## Lab Content

- A. Student will identify the different parts of a motor.
- B. Student will identify different control devices for motors.
- C. Student describe the sequence of operation of a motor control drawing.

## Special Facilities and/or Equipment

Laboratory with electrical tools and equipment.

## Method(s) of Evaluation

Methods of Evaluation may include but are not limited to the following:

- Results of written quizzes and average of six tests
- Results of hands-on projects and homework
- Results of class participation
- Maintenance of a student's workbook with questions drawn from text

## Method(s) of Instruction

Methods of Instruction may include but are not limited to the following:

- Lecture
- Lab assignments
- Group discussion
- Class demonstrations

## Representative Text(s) and Other Materials

Johnston, M.J.. Hazardous Locations. 2007.

American Technical Publishers, Inc.. Motors, 2nd ed.. 2010.

National Joint Apprenticeship and Training Committee. Fundamentals of Motor Control. 2010.

National Joint Apprenticeship and Training Committee. Syllabus for Fourth Year Core Curriculum. 2014.

National Joint Apprenticeship and Training Committee. Code and Practices -4 & 5 Student Blended Learning. 2014.

National Joint Apprenticeship and Training Committee. Hazardous Locations Student Blended Learning. 2006.

National Joint Apprenticeship and Training Committee. Motors Student Workbook. 2005.

National Joint Apprenticeship and Training Committee. Motor Control Student Blended Learning. 2010.

These are the standard Electrical textbooks/workbooks used for this course. Although one or more may not be within 5 years of the required published date, they are the most current books used when teaching this course.

## Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

- A. Read the publication titled "Hazardous Locations" by the International Association of Electrical Inspectors.
- B. Read Syllabus for Fourth Year Core Curriculum in the National Joint Apprenticeship and Training Committee (NJATC).
- C. Prepare a diagram of the sequence of operations for a motor control drawing.

## Discipline(s)

Electricity