APEL 127A: ADVANCED MOTOR CONTROLS, VARIABLE FREQUENCY DRIVES, PROGRAMMABLE LOGIC CONTROLS

Foothill College Course Outline of Record

Heading	Value
Effective Term:	Summer 2025
Units:	5
Hours:	48 lecture, 48 laboratory per quarter (96 total per quarter)
Prerequisite:	Per California Code of Regulations, this course is limited to students admitted to the San Francisco Inside Wireman Electrical Program.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Non-GE
Transferable:	None
Grade Type:	Letter Grade (Request for Pass/No Pass)
Repeatability:	Not Repeatable

Student Learning Outcomes

- A student will be able toÊÊinstall and program an electric motor drive, and wire and program a PLC.
- A student will be able to wire a motor control circuit to control a motor starter using manual and automatic inputs (switches).

Description

Introduction to the principles of motor speed control using variable frequency drives. Introduction to programmable logic controllers (PLCs).

Course Objectives

The student will be able to:

1. Recall the wiring schemes for basic motor control circuits such as three-wire start stops, hand-off-auto, and reversing circuits.
2. Demonstrate their ability to wire motor control circuits using manual and automatic pilot devices.
3. Explain basic motor control-related definitions in their own words.
4. Make use of appropriate troubleshooting procedures for motor control circuits.
5. Demonstrate their ability to troubleshoot variable frequency drive (VFD) installations.
6. Demonstrate their ability to make motor connections in VFD installations.
7. Show their ability to use test instruments to measure electrical quantities like ohms, hertz, volts, and amps in VFD installations.
8. Describe VFD operational principles.
9. Identify solutions for common issues with VFD installations.
10. Show their knowledge of control circuit logic.
11. Demonstrate their ability to program a programmable logic controller (PLC) with appropriate circuit logic.
12. Demonstrate their ability to properly wire up a motor control circuit that is controlled by a PLC.

Course Content

1. Advanced motor control
   a. Motor control circuit logic
   b. Contactors and starters
   c. Manual motor control
   d. Automatic motor control
   e. Switch installation
   f. Relays
   g. Time delay applications
   h. Reversing motor circuits
   i. Troubleshooting
2. Variable frequency drives (VFDs)
   a. Electrical safety
   b. Electric motor loads
   c. Electric motor types
   d. Electric motor control
   e. Electric motor installation
   f. VFD operation and installation
   g. VFD programming
   h. Test tools for VFDs
   i. VFD start-up and troubleshooting
3. Programmable logic controls (PLCs)
   a. PLC inputs and outputs
   b. PLC auxiliary relays and inputs
   c. PLC wiring
   d. PLC logic
   e. PLC programming

Lab Content

1. Advanced motor controls
   a. Wiring up advanced motor control circuits using manual and automatic pilot devices and relays
   b. Troubleshooting motor control circuits
2. Variable frequency drives (VFDs)
   a. Motor connections
   b. Insulation resistance testing
   c. Programming VFDs
   d. Testing solid-state components
3. Programmable logic controls (PLCs)
   a. Wiring up motors and motor starters to be controlled by PLCs
   b. Programming PLCs
   c. Troubleshooting PLCs

Special Facilities and/or Equipment

1. Laboratory with motors, motor starters, VFDs, PLCs, and test instruments.

2. When taught via Foothill Global Access, on-going access to computer with software and hardware capable of running video conferencing applications (e.g., Zoom).

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
Demonstration
Laboratory

Representative Text(s) and Other Materials

Mazur, Glen, and William Weindorf. Electric Motor Drive Installation and Troubleshooting. 2015.

Mazur, Glen, and William Weindorf. Printreading for Installing and Troubleshooting Electrical Systems. 2015.

National Fire Protection Association. NFPA 70 National Electric Code. 2023.

NJATC. Fundamentals of Motor Controls. 2010.

These are the most current versions of these texts and have been deemed the most appropriate for the course. The newest editions will be adopted as they are made available.

Manufacturers' instruction manuals for VFDs, PLCs, and motor control devices.

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

Read Chapter 1 in Electric Motor Drive Installation and Troubleshooting textbook and submit questions and answers via the testing system.

Discipline(s)

Electricity