CUSTOMIZED TEACHER ASSESSMENT BLUEPRINT

ELECTROMECHANICAL ENGINEERING TECHNOLOGY PA

Test Code: 5936
Version: 01

Specific competencies and skills tested in this assessment:

Technical Documentation and Safety
Identify components of technical reports
Demonstrate knowledge of the common components of technical documents
Demonstrate knowledge of accident prevention
Identify safe work habits
Demonstrate safe and proper use of hand tools
Demonstrate safe and proper use of portable power tools
Demonstrate safe and proper use of the drill press
Describe the dangers of unruly behavior
Identify electric shock hazards
Identify fire dangers of electronic circuits
Use appropriate fire extinguishers for different classes of fires
Describe the importance of SDS information
Describe and understand Arc Flash Protection and National Fire Protection Act 70E
Describe and demonstrate the Lock-Out/Tag-Out procedure

Industrial Motor Controls
Identify and interpret electrical symbols, notes, details, and components on schematics
Identify symbols and terms used in electromechanical motor control circuits
Identify relays, contactors, and motor starters
Read schematic wiring diagrams of motors and their controls
Wire a simple two- and three-wire motor control circuit
Wire a reversing starter
Wire multiple push button/jogging control circuits
Wire sequential control circuits
Wire and test electrical control circuits
Perform preventive maintenance and troubleshooting on motor controls
Identify and describe classes of wire insulation
Describe conductor ampacity
Describe how to select “wire size” and “wire type” for a specific wiring application
Demonstrate procedures for the correct labeling of wires
Interpret electrical diagrams
Troubleshoot and replace relays

Electromechanical Engineering Technology PA (continued)

Fundamentals of Electricity
Describe the origins and applications of magnetism
Describe the idea of a magnetic force
Describe the atomic structure of materials
Describe the direction of electron flow in circuits
List the effect of electric current flow
Construct simple circuits
Define electricity
Describe the electrical force, which causes current flow
Describe the characteristics and purposes of good conductors of electricity
Demonstrate the use of prefixes in the metric system of measurement
Demonstrate knowledge of "power"
State Ohm's Law
State Watt's Law
Use an analog and a digital multimeter to measure voltage, amperage, and resistance
Use and care for analog and digital meters
Perform a continuity test
Define resistance
Describe how length and thickness of wire affect resistance
Measure resistance using a meter
Calculate resistance
Describe how the flow of an electric current generates heat
Calculate total resistance values
Identify values for color-coded resistors
Describe the operation of a capacitor
Build and test a series circuit
Build and test a parallel circuit
Build and test a series/parallel circuit
Troubleshoot series and parallel circuits
Calculate voltage, current, and resistance
Measure voltage, current, and resistance

Use the National Electric Code® (NEC) Reference Book
Describe regulations for wiring
Explain the NEC® code for sizes and types of wire conductors, raceways, and boxes
State the NEC rules for grounding and bonding
Describe the NEC rules for over-current protection devices
Locate the NEC code for motor circuit wiring
Use the NEC reference book to locate regulations for industrial electrical installations

Motors and Transformers
Demonstrate knowledge of basic direct current circuits
Explain the theory of operation of a direct current motor
Operate and test a direct current motor
Demonstrate knowledge of technical terms and units used in a basic direct current circuit
Explain the theory of operation of alternative current motors
Describe operating characteristics of capacitor-start motors
Connect and operate split-phase and capacitor-start motors
Reverse the rotation of a split-phase motor
Describe the force between two magnetic fields
Connect and operate a three-phase, squirrel cage motor
Demonstrate how to reverse the rotation of a three-phase motor
Connect and operate a transformer
Calculate the voltage-and-turns ratio

Connect a "step-up" and a "step-down" transformer in a circuit
Identify transformer windings and related output voltages
Measure single-phase transformer voltage and currents
Measure series/parallel transformer voltages and currents
Demonstrate knowledge of three-phase transformers
Wire and analyze three-phase transformers

Electronic Fundamentals
Describe proper care for soldering equipment
Demonstrate proper soldering techniques for splicing conductors
Demonstrate proper soldering techniques for terminals
Identify and explain electronic symbols shown on diagrams and schematics
Describe and explain the function of diodes
Explain the function of Zener diodes
Explain the function of power supplies
Explain the function of half-wave, full-wave, and three-phase rectifiers
Explain the function of single-phase and three-phase inverters

Programmable Logic Controllers (PLCs)
Demonstrate knowledge of number systems
Convert binary and decimal number systems
Demonstrate knowledge of switch logic
Identify characteristics of AND, OR, NAND, NOR, and NOT logic
Demonstrate knowledge of AND, OR, NAND, NOR, and NOT logic
Explain where PLC networks may be used in the manufacturing process
Identify the parts and operating principles of programmable logic controllers
Demonstrate knowledge of number systems and codes for PLCs
Create a relay logic diagram
Describe the PLC logic gate functions in PLCs
Explain PLC logic and math functions
Explain PLC timer and counter functions
Demonstrate procedures for editing PLC programs
Troubleshoot a PLC system

Mechanical Power Transmission Systems
Identify vocabulary words and terms associated with the fundamental principles of the transmission of mechanical power
Construct simple machines and use them to illustrate mechanical principles
Identify basic principles of lubrication of bearings
Identify basic principles of installing and adjusting V-belts
Demonstrate knowledge of the uses of brakes and clutches for mechanical power transmission
Set and adjust mechanical stops
Install and maintain linkages
Install and maintain gear trains
Conduct routine preventive maintenance on hydraulic equipment in accordance with manufacturer's instructions
Determine speed and torque rates of mechanical equipment components

Electromechanical Engineering Technology PA (continued)

Fluid Power Systems

Identify electrical symbols and schematics for hydraulic systems
Demonstrate knowledge of the fundamentals of hydraulics
Examine characteristics of hydraulic pumps
Measure oil flow and oil pressure
Demonstrate the operation of manual and pilot directional control valves
Describe and explain hydraulic actuators
Describe the relationship between hydraulic pressure and flow
Demonstrate knowledge of the fundamental principles of pneumatics
Demonstrate knowledge of pneumatic actuators
Construct, test, and troubleshoot a pneumatic circuit

Automated Manufacturing Systems

Demonstrate knowledge of safety rules and regulations for working around robots
Use vocabulary words and terms specific to robotics
Identify major systems of a robot
Identify a robot's "work envelope'' in a manufacturing cell
Explain how robots are used in American manufacturing industries
Describe the operation of a robot's drive system
Describe the mobility of an industrial robot
Demonstrate the procedure for programming a robot
Describe industrial applications for robotics
Demonstrate knowledge of the fundamental operating principles used in flexible manufacturing systems
Assemble and test a fluid power work-cell using PLC sensors

Written Assessment:

Administration Time: 3 hours
Number of Questions: 195

Areas covered:

10%	Technical Documentation and Safety
15%	Industrial Motor Controls
21%	Fundamentals of Electricity
4%	Use the National Electric Code (NEC) Reference Book
13%	Motors and Transformers
6%	Electronic Fundamentals
10%	Programmable Logic Controllers (PLCs)
7%	Mechanical Power Transmission Systems
7%	Fluid Power Systems
7%	Automated Manufacturing Systems

Sample Questions:

NFPA 70E® is a regulation that provides guidelines and details for

A. fire extinguisher use
B. proper material selection
C. electrical safety
D. scaffold use

The NEC states that a non-metallic sheathed cable be secured by staples or straps within _____ from every cabinet, box, or fitting.

A. 5 inches
B. 6 inches
C. 10 inches
D. 12 inches

Every digital multimeter can measure which three basic elements?

A. capacitance, voltage, and resistance
B. current, voltage, and resistance
C. current, voltage, and capacitance
D. capacitance, current, and resistance

The rate at which energy is consumed by a circuit is called

A. joules
B. power
C. current
D. voltage

Two XIC instructions placed in series with an output instruction is defined as _____ logic.

A. AND
B. OR
C. NOT
D. NOR

Performance Assessment:

Administration Time: 3 hours
Number of Jobs: 5

Areas Covered:

16% **Cut and Bend Conduit**
Participant will use safety considerations, demonstrate EMT cutting resulting in ends of conduit being square and deburred with proper bending.

15% **Wiring a Motor Control Circuit, Motor, and Indicator Light**
Participant will select conductors, demonstrate safe operation of a motor, and clean-up of the work area.

28% **DC Circuit Construction and Analysis**
Participant will select components, demonstrate construction of a circuit, use calculations and measurements with consideration for safety.

12% **Fluid Power**
Participant will use safety considerations, supply pressure safety, and circuit construction.

29% **PLC Logic**
Participant will input instruction type, E-stop, seal-in circuit, complete documentation, and final program logic.

Sample Job: Wiring a Motor Control Circuit, Motor, and Indicator Light

Maximum Job Time: 45 minutes

Participant Activity: The participant will study the diagram provided, select the tools, equipment, and supplies for proper completion of this job, wire the circuit according to the diagram provided, select and label the conductors, check for continuity of control circuit and motor wiring, notify the evaluator so installation can be approved, operate and troubleshoot as necessary, return tools, equipment, and supplies to their proper place, and notify the evaluator when ready for a final evaluation.