ELECTRICAL MACHINE CONTROL SYSTEMS

UNIT CODE: ENG/CU/ET/CR/03/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Install electrical machine control systems

Duration of Unit: 200 hours

Unit Description
This unit covers competencies required to install electrical machine control system. Competencies includes; conducting site survey, designing electrical machine control system, assembling tools, equipment and materials, mounting electrical and electronic components, wiring electrical and electronic components, terminating wiring of electrical and electronic components, configuring and testing the installed electrical machine control system, commissioning and documenting installation report.

Summary of Learning Outcomes
1. Conduct site survey
2. Design electrical machine control system
3. Assemble tools, equipment and materials
4. Mount electrical and electronic components
5. Perform wiring of electrical and electronic components
6. Terminate system wiring
7. Configure and test control system
8. Commission the system and document installation report

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods

1. Conduct site survey	• Utilities available
	  • Water
	  • Electricity
	  • Communication
	• Installation conditions
	  • Temperature,
	  • Humidity,
	  • Dust
	• Taking measurements on site
	  • Length e.g. conduits size
	  • Total area
	  • Temperature
	• Types of industrial layouts
	  • Process layout
	  • Product layout
	  • Hybrid layout
	  • Fixed position layout
	• Site survey report preparation
		• Observation
		• Oral questioning
		• Written tests
		• Practical tests

2. Design electrical machine control system	• Meaning of terms
	• Types of control system.
	  • Open loop control system
	  • Closed loop control system
	  • Logic control
	  • ON-OFF control
	  • Linear control
	  ➢ Proportional control
	  ➢ PID control
	• Components of a control system
	  • Input signal
	  • Sensing elements
	  • Process being controlled
	  • Controllers
	  • Output
	• Control system modeling
	• Calculations involving system modeling
		• Observation
		• Oral questioning
		• Written tests
		• Practical tests

Learning Outcome	Content	Suggested Assessment Methods

	• Control system methodologies
	  • Single input, single output (SISO)
	  • Multiple input, multiple output (MIMO)
	• Control system strategies
	  • Adaptive control
	  • Optimal control
	  • Intelligent control
	  • Robust control
	  • Stochastic control
	  • Hierarchical control
	• Use of machine manufacturer's manuals	

3. Assemble tools, equipment and materials	• Identification of tools and materials e.g.
	  • Cutting tools
	  • Measuring tools
	  • Measuring equipment
	  • Cables and conductors
	  • Crimping tool
	  • Conduits
	  • Trunking
	  • Consumables eg
	  • Cable strippers
	  • Pliers
	  • Screw drivers
	  • Hammers
	  • Chisels
	  • Allen keys
	  • Electrician knives
	  • Crimping tools
	  • Bending springs
	  • Steel tapes
	  • Draw wires
	  • Hack saws
	  • Drills
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

Learning Outcome	Content	Suggested Assessment Methods

	• Equipment e.g.
	  • Multimeters
	  • Computer
	• Materials e.g.
	  • Cables
	  • Fittings
	  • Accessories
	• Assemble tools, equipment and materials
	• Inventory management	

4. Mount electrical and electronic components	• Meaning of terms
	• Components of control system eg
	  • Sensors
	  • Actuators
	  • Limit switches
	  • Push buttons
	  • Logic gates
	  • Microcontrollers
	  • PLC
	  • SCADA
	  • Din rail
	  • Control panels
	  • Transmitters
	  • Timers
	  • Counters
	  • VSDs
	  • Contactors
	  • Relays
	• Interpreting the control design
	  • Design symbols
	  • Terminations
	  • Drawings
	• Types of enclosures
		• Written tests
		• Oral questioning
		• Practical tests
		• Observation

Learning Outcome	Content	Suggested Assessment Methods

5. Perform wiring of electrical and electronic components	• Meaning of terms
	• Motor control circuits
	  • Motor starters
	  • Interlocking
	• Cable sizes, ratings, color coding and marking
	• Type of wiring systems e.g.
	  • Surface wiring
	  • Batten wiring
	  • Conduit wiring
	  • Concealed wiring
	• Types of cables e.g.
	  • Armored cables
	  • Twisted cables
	  • Stranded cables
	  • Shielded cables
	  • Coaxial cables
	• IEE regulations
		• Observation
		• Oral questioning
		• Practical tests
		• Written tests

6. Terminate system wiring	• Meaning of terms
	• Factors determining type of termination
	  • Voltage
	  • Current
	  • Overhead or underground
	  • Outdoor or indoor
	  • Type of connectors
	• Methods of wiring termination e.g.
	  • Crimp connections
	  • Soldered connections
	  • Compression termination
	  • Wire wrapping connection
	  • Direct connection
	  • Loop or eye connection
	• Cable joints
	• Types of cable joints e.g.
		• Oral questioning
		• Observation
		• Written tests
		• Practical tests

Learning Outcome	Content	Suggested Assessment Methods
	• Straight through joint • Y and T type joint • Pot end joints • Indoor and outdoor • OSHA regulations • IEE regulations	

7. Configure and test control system	• Meaning of terms
	• Configuration of inputs and output
	• Test instruments
	• Visual inspection of the system
	• Types of tests on control system
	  • Test for input supply
	  • Short circuit tests
	  • Open circuit tests
	• Safety during testing power supply system
	• IEE regulation
	• Use manufacturer's manuals in testing system components
	• Test running the machine control system
		• Oral questioning
		• Observation
		• Written tests
		• Practical tests

8. Commission the system and document installation report	• User training • Preparation of system's standard operating procedures and manuals • Issuing of completion certificates • Preparation of installation reports • Sharing and documentation of installation reports • Commissioning of control system	• Oral questioning • Observation • Written tests • Practical tests

Suggested Methods of Instruction

- Demonstration by trainer
- Practice by the trainee
- Field trips

- Discussions

Recommended Resources

Installation instruments

- Electrical measuring instruments
- Tightening instruments
- Soldering instruments
- Computers

Materials and supplies

- Stationery
- PCBs
- Test Certificate
- Cables

Reference materials

- Manufacturers' manuals
- Relevant catalogues
- IEE regulations
- OSHA regulations