

## INDUSTRIAL AUTOMATION

**UNIT CODE:** ENG/CU/ET/CR/05/6/A

### Relationship to Occupational Standards

This unit addresses the unit of competency: Perform industrial automation

**Duration of Unit:** 250 hours

### Unit Description

#### UNIT DESCRIPTION

This unit covers competencies required to perform industrial automation. Competencies includes; install industrial sensors and transducers, install automation components and hardware, install machine systems, install robots and robotic systems and install programming software

### Summary of Learning Outcomes

1. Install industrial sensors and transducers
2. Install automation components and hardware
3. Install machine systems
4. Install robots and robotic systems
5. Install programming software

### Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Install industrial sensors and transducers	<ul style="list-style-type: none"><li>• Meaning of terms<ul style="list-style-type: none"><li>• Sensors</li><li>• Transducers</li></ul></li><li>• Types of sensors and transducers eg<ul style="list-style-type: none"><li>• Resistance type</li><li>• Inductance type</li><li>• Capacitance type</li></ul></li><li>• Classification of transducers</li><li>• Types of actuators<ul style="list-style-type: none"><li>• Pneumatic actuators</li><li>• Hydraulic actuators</li><li>• Electric actuators</li></ul></li><li>• Meaning of signal conditioning</li></ul>	<ul style="list-style-type: none"><li>• Written tests</li><li>• Oral questioning</li><li>• Observation</li><li>• Practical tests</li></ul>

Learning Outcome	Content	Suggested Assessment Methods
	<ul style="list-style-type: none"> <li>• Processes in signal conditioning</li> <li>• Operational amplifiers</li> <li>• Applications of operational amplifiers</li> <li>• Filters</li> <li>• Attenuators</li> <li>• EHS standards</li> <li>• IEE regulations</li> </ul>	
2. Install automation components and hardware	<ul style="list-style-type: none"> <li>• Meaning of terms</li> <li>• Controllers <ul style="list-style-type: none"> <li>• Process modeling</li> <li>• Transfer functions</li> <li>• Open loop and closed loop controls</li> </ul> </li> <li>• Applications of controllers <ul style="list-style-type: none"> <li>• Proportional controllers</li> <li>• Integral controllers</li> <li>• PID controllers</li> <li>• Feedback and feed forward control</li> <li>• Cascade/selective control</li> </ul> </li> <li>• Industrial computers <ul style="list-style-type: none"> <li>• Industrial computer hardware and software</li> <li>• Memory and memory addressing</li> <li>• Signal conditioning</li> <li>• Computer interfacing</li> <li>• Computer networking</li> <li>• PLC and SCADA</li> </ul> </li> <li>• Distributed Control Systems <ul style="list-style-type: none"> <li>• Components of DCS</li> <li>• DCS configuration</li> <li>• Application of DCS</li> </ul> </li> <li>• Programmable Logic Controllers <ul style="list-style-type: none"> <li>• Hardware</li> <li>• Internal architecture</li> <li>• Input/output devices and their</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Oral questioning</li> <li>• Practical tests</li> <li>• Written tests</li> </ul>

Learning Outcome	Content	Suggested Assessment Methods
	<p>applications</p> <ul style="list-style-type: none"> <li>• Number systems <ul style="list-style-type: none"> <li>• PLC data</li> </ul> </li> <li>• Input and output processing <ul style="list-style-type: none"> <li>• Signal conditioning</li> <li>• Remote connections</li> <li>• Networks</li> <li>• Input/output addresses</li> </ul> </li> <li>• Ladder and functioning block diagrams <ul style="list-style-type: none"> <li>• Ladder diagrams</li> <li>• Logic functions</li> <li>• Latching</li> <li>• Multiple outputs</li> <li>• Entering programs</li> <li>• Function blocks</li> </ul> </li> <li>• IL, SFC and ST programming methods <ul style="list-style-type: none"> <li>• Instruction lists</li> <li>• Sequential function charts</li> <li>• Structured text</li> </ul> </li> <li>• Internal relay <ul style="list-style-type: none"> <li>• Ladder programs</li> <li>• Battery-backed relays</li> <li>• One-shot operation</li> <li>• Set and reset</li> <li>• Master control relay</li> </ul> </li> <li>• Subroutine and interrupts <ul style="list-style-type: none"> <li>• Subroutine</li> <li>• Interrupt</li> </ul> </li> <li>• Data handling <ul style="list-style-type: none"> <li>• Registers and bits</li> <li>• Shift registers</li> <li>• Flip flops</li> <li>• Ladder programs</li> <li>• Data handling</li> </ul> </li> </ul>	

Learning Outcome	Content	Suggested Assessment Methods
	<ul style="list-style-type: none"> <li>• Arithmetic functions</li> <li>• Closed loop control</li> <li>• Components <ul style="list-style-type: none"> <li>• Timers</li> <li>• Counters</li> </ul> </li> <li>• Programs <ul style="list-style-type: none"> <li>• Program development</li> <li>• Temperature control</li> <li>• Valve sequencing</li> <li>• Conveyor belt control</li> <li>• Control of a process</li> </ul> </li> <li>• Human machine Interfaces <ul style="list-style-type: none"> <li>• Programming human machine interfaces</li> </ul> </li> <li>• Encoders and resolvers <ul style="list-style-type: none"> <li>• Application of encoders and resolvers</li> </ul> </li> <li>• Output devices <ul style="list-style-type: none"> <li>• LED</li> <li>• LCD screen</li> <li>• Monitors</li> <li>• Buzzers</li> <li>• Pilot lights</li> <li>• Solenoid valves</li> </ul> </li> <li>• Barcodes, RFIDS, Inductive IDS <ul style="list-style-type: none"> <li>• Types</li> <li>• Components</li> <li>• Application</li> </ul> </li> <li>• Power control devices eg <ul style="list-style-type: none"> <li>• Power diodes</li> <li>• Thyristors</li> <li>• Diacs</li> <li>• Triacs</li> <li>• Triodes</li> <li>• Transistors</li> </ul> </li> </ul>	

Learning Outcome	Content	Suggested Assessment Methods
	<ul style="list-style-type: none"> <li>• Snubbers</li> <li>• Wiring and termination of cables</li> <li>• Distribution block</li> <li>• Transformers in automation systems               <ul style="list-style-type: none"> <li>• Pulse transformer</li> <li>• Variable frequency transformer</li> <li>• Radio frequency transformer</li> <li>• Instrument transformer</li> <li>• Resolver and synchro transformer</li> <li>• Piezoelectric transformer</li> <li>• Intermediate frequency transformer</li> </ul> </li> <li>• Power supply               <ul style="list-style-type: none"> <li>• Components</li> <li>• Applications</li> </ul> </li> <li>• Motors               <ul style="list-style-type: none"> <li>• Servomotors and stepper motors</li> <li>• Variable frequency drives</li> <li>• Servomechanisms</li> <li>• Types of servomechanisms</li> </ul> </li> <li>• Enclosures               <ul style="list-style-type: none"> <li>• Types of enclosures</li> </ul> </li> <li>• Insulation classes</li> <li>• IEE regulations</li> <li>• OSHA regulations</li> <li>• NEMA regulations</li> </ul>	
3. Install machine systems	<ul style="list-style-type: none"> <li>• Meaning of terms</li> <li>• Conveyors               <ul style="list-style-type: none"> <li>• Types of conveyors eg                   <ul style="list-style-type: none"> <li>• Belt conveyor</li> <li>• Roller conveyors</li> <li>• Chain and mat conveyors</li> <li>• Rubber conveyors</li> <li>• Vibrating conveyors</li> <li>• Pneumatic conveyors</li> </ul> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Oral questioning</li> <li>• Practical tests</li> <li>• Observation</li> <li>• Written tests</li> </ul>

Learning Outcome	Content	Suggested Assessment Methods
	<ul style="list-style-type: none"> <li>• Conveyor accessories</li> <li>• Indexers and synchronous machines               <ul style="list-style-type: none"> <li>• Rotary cam indexers</li> <li>• Synchronous chassis pallet</li> <li>• Walking beams</li> <li>• Pick and place</li> </ul> </li> <li>• Part feeders               <ul style="list-style-type: none"> <li>• Vibratory bowls and feeders</li> <li>• Step and rotary feeders</li> <li>• Escapements and parts handling</li> </ul> </li> </ul>	
4. Install robots and robotic systems	<ul style="list-style-type: none"> <li>• Meaning of terms</li> <li>• Components of a robot</li> <li>• Robot configuration               <ul style="list-style-type: none"> <li>• Articulated robots</li> <li>• Selective Compliant Assembly Robot Arm (SCARA robots)</li> <li>• Cartesian Robots</li> <li>• Parallel robots</li> </ul> </li> <li>• Robot coordinate systems</li> </ul>	<ul style="list-style-type: none"> <li>• Oral questioning</li> <li>• Practical tests</li> <li>• Observation</li> <li>• Written tests</li> </ul>
5. Install programming software	<ul style="list-style-type: none"> <li>• Meaning of terms</li> <li>• PLC software brands eg               <ul style="list-style-type: none"> <li>• Siemens</li> <li>• ABB</li> <li>• Schneider</li> <li>• Allen-Bradley</li> <li>• Rockwell</li> <li>• Berckoff</li> <li>• Mitsubishi</li> <li>• Omron</li> </ul> </li> <li>• Programming concepts</li> <li>• Programming methodologies</li> <li>• Programming languages</li> <li>• Programming PLC, DCS, embedded systems, robot controller</li> </ul>	<ul style="list-style-type: none"> <li>• Practical tests</li> <li>• Oral questioning</li> <li>• Observation</li> <li>• Written tests</li> </ul>

Learning Outcome	Content	Suggested Assessment Methods
	<ul style="list-style-type: none"> <li>• Factors to consider in program development</li> <li>• Piping and instrumentation diagrams</li> <li>• Use of CAD in developing piping and instrumentation diagrams</li> <li>• Analysis softwares eg               <ul style="list-style-type: none"> <li>• Matlab</li> <li>• Labview</li> <li>• Multisim</li> </ul> </li> <li>• Supervisory Control and data acquisition (SCADA)</li> </ul>	

#### **Suggested Methods of Instruction**

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

#### **Recommended Resources**

##### **Industrial automation components**

- Computers,
- PLCs
- Programming softwares
- Power control devices
- Sensors and transducers
- Insulation resistance tester
- Motors

##### **Materials and supplies**

- Stationery
- Installation Certificates

##### **Reference materials**

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