

## **Course Overview for: IND120 Industrial Electricity I, 3 Credit Hour; 4/9/17**

### Course Description:

This is an introductory course on the study of basic electrical concepts and circuits. The course will be based on Direct Current (DC) and Alternating Current (AC) concepts, terminology, components, and basic series/parallel circuits. Students will learn how to calculate and measure voltage, current and resistance in basic series and parallel circuits. Students will learn how to utilize a Digital Multi-meter (DMM) to troubleshoot components in an electrical circuit, and test stand-alone components. The students will be introduced to DC and AC relay circuits, as well as electrical symbols that will be used on electrical prints. The course will have a heavy focus on troubleshooting concepts and techniques when working with electrical circuits.

### This course will consist of 12 competencies:

1. Explain basic electrical concepts and terminology
2. Explain the operation and application of electrical switches
3. Explain and wire DC Circuits (series & parallel)
4. Explain and apply various types of electrical test equipment
5. Explain and apply Alternating Current concepts.
6. Explain and apply DC & AC relays, and solenoids
7. Explain and apply voltage divider circuits
8. Explain and apply capacitors and inductors in electric circuits
9. Explain and apply DC and AC types of motors
10. Interpret basic electrical symbols and prints
11. Explain and wire a basic electrical control circuit
12. Troubleshoot basic electrical components and circuits

### This course will consist of the following 8 Modules:

Module #1: Basic electrical concepts, terminology and multi-meters

Module #2: Basic electrical concepts, switches and circuits

Module #3: Direct Current circuits, series & parallel

Module #4: Voltage Dividers, Capacitors and Inductors in Electrical Circuits

Module #5: Alternating Current basics

Module #6: DC & AC Relay, circuits, and Solenoids

Module #7: Troubleshooting Electrical Circuits

Module #8: Industrial Control Circuits

### **Module 1: Basic electrical concepts, terminology and multi-meters: Hands-On Assessment Tasks:**

1. Identify and explain two sources of direct current.
2. Measure a specified resistor with a digital multi-meter.
3. Measure the voltage across both the DC and AC power sources
4. Wire a basic DC series circuit of P/S, switch and pilot light.
5. Measure the voltage across each component in this series circuit
6. Measure and explain the resistance of a toggle switch when on, then off

### **Module 2: Basic electrical concepts, switches and circuits: Hands-On Assessment Tasks:**

1. Identify and explain the various types of switches on the AC/DC training system (SPST, SPDT, DPDT, N.O. Pushbutton)
2. Measure the continuity of each switch.
3. Wire a circuit with a DPDT switch with two different loads as shown below.
4. Measure the voltage across one of the open contacts? What is the value?
5. Wire a circuit with 2 switches in series driving a pilot light as shown below.
6. Student must explain what condition turns the indicator light on, and what two conditions would shut it off.
7. Wire a circuit with 2 switches in parallel driving a pilot light as shown below.
8. Student must explain what conditions turn the indicator light on, and what conditions would shut it off.

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### **Module 3: Direct Current circuits, series & parallel: Hands-On Assessment Tasks:**

1. Wire a series circuit with a switch and two resistors
2. Calculate and measure the total resistance of a series circuit.
3. Calculate the total current that will flow when the switch is closed.
4. Measure the total current that will flow in a series circuit when the switch is closed.
5. Wire the parallel circuit with a switch and two resistors as shown below
6. Calculate and measure the total resistance of a parallel circuit.
7. Calculate and measure the total current in a parallel circuit.
8. Calculate and measure the current in each leg of a parallel circuit.

### **Module 4: Voltage Dividers, Capacitors and Inductors in Electrical Circuits: Hands-On Assessment Tasks:**

1. Wire a series circuit with a switch and three resistors.
2. Calculate and measure the total resistance in the series circuit with three resistors..
3. Calculate and measure the voltage drop across each resistor, if the switch is closed.
4. Wire a rheostat in series with a switch and DC motor, and vary the speed of the motor
5. Wire a voltage divider circuit with potentiometer and a set resistor.
6. Calculate and measure the voltage drops across the potentiometer and the 120 Ohm resistor

### **Module 5: Alternating Current basics: Hands-On Assessment Tasks:**

1. Calculate the Peak voltage from an RMS measurement using a DVM.
2. Test the voltage on a 120VAC outlet.
3. Identify the hot, neutral and grounding wire connections on a 120VAC outlet
4. Explain the difference between a short circuit and an overload
5. Explain the continuity between a transformer primary and secondary
6. Wire a basic transformer circuit with 2 resistive loads on the secondary
7. Measure the AC voltage on the primary/secondary of a transformer
8. Explain the relationship between current and voltage on a transformers primary and secondary winding

### **Module 6: DC & AC Relay, circuits, and Solenoids: Hands-On Assessment Tasks:**

1. Wire a relay circuit with two loads connected to a N.O. and N.C. contacts.
2. Explain how the NO and NC contacts work in this circuit.
3. Explain the voltage drop at each node of a basic relay circuit
4. Identify the components on relay cut-sheet, and what is the continuity between the terminals.
5. Correlate the diagram on a relay cut-sheet, to the actual relay components.
6. Explain the operation of a basic relay circuit (start/stop circuit), and the purpose of each component.
7. Explain the voltage drops that should be measured on each electrical node if the relay is pulled in, and also when it is off.

### **Module 7: Troubleshooting Electrical Circuits: Hands-On Assessment Tasks:**

1. Wire and explain the operation of a 24Vac series/parallel circuit with two SPDT switches and 3 pilot lights.
2. Troubleshoot a 24Vac series/parallel circuit with two SPDT switches and 3 pilot lights, with an injected fault.
3. Wire and explain the operation of a relay circuit with a start/stop/hold-in control and two pilot lights.
4. Troubleshoot a relay circuit with a start/stop/hold-in control and two pilot lights, with an injected fault.
5. Wire and explain the operation of a 24Vac series/parallel circuit with three SPDT switches, pilot lights and motor.
6. Troubleshoot a 24Vac series/parallel circuit with three SPDT switches, pilot lights and motor, with an injected fault.

### **Module 8: Industrial Control Circuits: Hands-On Assessment Tasks:**

1. Identify and explain the purpose of time delay relays, proximity & photo-electric switches, limit & selector switches
2. Correlate an electrical print symbol to the control device ( time delay relays, proximity & photo-electric switches, limit & selector switches)
3. Wire a 3-wire control, start/stop circuit running a motor starter.
4. Number the electrical nodes of the start/stop circuit and take appropriate voltage checks
5. Troubleshoot a start/stop motor control circuit, with an injected fault.
6. Explain the operation of start/stop circuit, and how the overload relay will reset the circuit.
7. Explain how to wire additional start pushbuttons and stop pushbuttons in the circuit.