Northwest State Community College  
Course Information Sheet

# Course Information

Title: Industrial Electricity 2B

Course Number: PLC 124

Credit Hours: 1

Pre-requisite: PLC123

# Description

The purpose of PLC 124 is to develop the student’s knowledge and skills in the area of electrical safety, DC/AC machines, and basic control circuits. The electrical safety module will focus on lockout/tagout, arc-flash standards, PPE, electrical panels, and overcurrent protection. The DC/AC machines will focus on the wiring and troubleshooting of DC shunt motors, single phase motors (split-phase, capacitor-start, and permanent capacitor), dual voltage transformers, and three phase motors. The basic control circuits will consist of start/stop/jog, dual start/stop, sequence circuits, and reversing circuits. There will also be a module focused on the installation of a PLC system (based on the Micrologix 1200 PLC). Students will learn how to utilize test equipment and electrical prints to troubleshoot electrical systems.

# Learning Outcomes

Upon completion of this course the students will be able to:

1. Wire a dual voltage transformer for step-up and step-down configuration
2. Explain industrial power and control voltages
3. Install electrical control circuits
4. Troubleshoot electrical control circuits

# Required Material

**Text:**

Electrical Motor Controls (For Integrated Systems), 5th Edition, by Gary Rockis & Glen Mazur.   
ISBN: 978-0-8269-1226-8

Ugly’s Electrical References, 2020 Edition.  
ISBN: 978-1284194531

**Supplies:**

Calculator

Safety Eyewear

Wire Strippers

Wiring Kit

# Module 1 - DC/AC Machines II (Single Phase Motors & Transformers)

Module 1 will introduce the students to single phase AC motors, both how they work and how to troubleshoot common single phase motors in the industrial workplace.  Split-phase, Capacitor-start and Permanent Capacitor motors will be discussed and used in the lab.  Students will also put these motors under load to simulate a real situation on a machine.  Students will also be introduced to industrial grade single phase transformers, transforming 120V and 208V AC single phase, on dual voltage rated transformers.

Upon completion of this module the student will be able to:

1. Wire and troubleshoot a single phase AC motor
2. Test the insulation on an AC motor with a megger
3. Test the current of an AC motor with a clip on ammeter
4. Interpret the nameplate of an AC single phase motor
5. Reverse the rotation of a single phase AC motor
6. Explain the effect of a mechanical load an AC motor (load vs. current)
7. Wire a dual voltage rated transformer
8. Troubleshoot a basic transformer circuit
9. Calculate the transformer current and capability based on nameplate data
10. Interpret the transformer nameplate and explain how a transformer works

### Module 1 Activities

Top of Form

 Read Electrical Motor Controls, pages 77-79 - Test Equipment, Clip-on ammeters

Text Book

 Read Electrical Motor Controls, pages 297-320 - AC Motors

Text Book

 Read Electrical Motor Controls, pages 225-232 – Transformers

Text Book

 Watch video: How DC motors and universal motors work (7:22)

<https://woodgears.ca/motors/dc.html>

 Complete Quiz 124-1

See Quiz PLC124-1 Content Packaging files to upload into an LMS System

 Review Hands-on Lab 124-1.1, Lab 124-1.2 and Lab 124-1.3

See Lab Documents

 Schedule and complete Hands-on Lab 124-1.1

See PLC124 1.1 Lab Document

 Schedule and complete Hands-on Lab 124-1.2

See PLC124 1.2 Lab Document

 Schedule and complete Hands-on Lab 124-1.3

See PLC124 1.3 Lab Document

Bottom of Form

# Module 2 - Control Circuits I (AC Three Phase Motors)

Module 2 will introduce the students to the AC three phase motor, which is the workhorse of industry.  Students will learn the operation, wiring and troubleshooting of these machines.  Students will also be introduced to motor branch circuits and see how these motors are used with a motor starter that will be used to control and protect the motor.  Students will load the three phase motors down with a prony brake to see how loads affect the motor and power feed to the motor.  Students will also be introduced to full electrical prints, which will be a critical part of their troubleshooting process

Upon completion of this module the student will be able to:

1. Wire a 9 lead dual voltage three phase motor for high or low voltage
2. Interpret the nameplate data on an AC three phase motor
3. Reverse the rotation of a three phase motor
4. Troubleshoot the power circuit of an industrial motor branch circuit
5. Measure the current of a loaded 3 phase motor with a Clip-on ammeter
6. Single phase a loaded 3 phase motor and explain the change
7. Explain how to vary the speed of a three phase motor
8. Measure and explain the voltage on a 208V three phase 4-wire system
9. Interpret electrical prints with motor branch circuits

### Module 2 Activities

Top of Form

 Read Electrical Motor Controls, pages 301-320 - Three Phase Motors

Text Book

 Read Electrical Motor Controls, pages 237-255 - Magnetic Contactors

Text Book

 Read Electrical Motor Controls, pages 256-269 - Magnetic Motor Starters

Text Book

 Watch video: AC Motor Basics (3:12)

<https://www.youtube.com/watch?v=59HBoIXzX_c>

 Complete Quiz 124-2

See Quiz INT124-2 Content Packaging files to upload into an LMS System

 Review Hands-on Lab 124-2.1 and Lab 124-2.2

See Lab Documents

 Schedule and complete Hands-on Lab 124-2.1

See PLC124 2.1 Lab Document

 Schedule and complete Hands-on Lab 124-2.2

See PLC124 2.2 Lab Document

Bottom of Form

# Module 3 - Control Circuits I (Start/Stop/Jog, Dual Start/Stop, Multiple Start/Stop)

Module 3 will introduce the students to basics of control circuit wiring for an industrial machine.  Though some control was introduced in Industrial Electrical I, this course will focus on the standards of electrical prints, wire colors and wiring numbering used in a control panel.  Students will focus on wiring and troubleshooting a start/stop, a start/stop/jog, a dual start/stop and a sequence control type of circuits on an NSCC wiring board, which will be 120VAC control circuit.  A heavy focus will be based on developing the troubleshooting skills of the students.

Upon completion of this module the student will be able to:

1. Interpret the line numbers and cross reference info on an electrical print
2. Explain the operation of a 3 wire control circuit
3. Wire and troubleshoot a run/jog motor control circuit
4. Wire and troubleshoot a dual start/stop motor control circuit
5. Wire and troubleshoot a multiple start/stop control circuit
6. Identify electrical symbols on an electrical print
7. Explain what the color of wires should be from reading a print

### Module 3 Activities

Top of Form

 Read Electrical Motor Controls, pages 39-56 - Symbols and Diagrams

Text Book

 Read Electrical Motor Controls, pages 115-139 - Control Logic

Text Book

 Watch video: How to Read Electrical Diagrams (10:53).

<https://www.youtube.com/watch?v=GHhcyH99inE>

 Read article: Wiring Methods for Industrial Machinery

<https://www.ecmweb.com/content/article/20889040/wiring-methods-for-industrial-machinery>

 Review website: Electrical Hook-up / Building Wire

<https://www.automationdirect.com/adc/overview/catalog/bulk_wire_-a-_cable/single_conductor_wire_-a-_cable>

 Review image: Industrial Wire Color Chart

<https://www.bradyid.com/resources/wiring-color-codes>

 Complete Quiz 124-3

See Quiz PLC124-3 Content Packaging files to upload into an LMS System

 Review Hands-on Lab 124-3.1, Lab 124-3.2, Lab 124-3.3, and Lab 124-3.4

See Lab Documents

 Schedule and complete Hands-on Lab 124-3.1

See PLC124 3.1 Lab Document

 Schedule and complete Hands-on Lab 124-3.2

See PLC124 3.2 Lab Document

 Schedule and complete Hands-on Lab 124-3.3

See PLC124 3.3 Lab Document

 Schedule and complete Hands-on Lab 124-3.4

See PLC124 3.4 Lab Document

Bottom of Form

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