

**Course Competencies:**

1. Explain the basic elements of a process control system.
2. Setup and maintain instrument devices that control and monitor analog signals.
3. Interpret electrical control prints and Piping & Instrument Diagrams.
4. Install/maintain an instrument loop controlled with a stand alone controller.
5. Install/maintain an instrument loop controlled with a PLC.
6. Explain a process circuit that monitors and controls temperature.
7. Explain a process circuit that monitors and controls level.
8. Explain a process circuit that monitors and controls pressure & flow.
9. Setup and troubleshoot a process control loop.

Proposed Modules in IND221 (for Fall 2023 8B):

- M1 - Introduction to Instrumentation Basics
- M2 - P&ID Diagrams and Single-Loop Controllers
- M3 - PLC Controllers for Analog Control
- M4 - Controls on the Festo Process Trainer
- M5 - Temperature Sensors & Controls
- M6 - Level Sensors & Controls
- M7 - Flow/Pressure Sensors & Controls
- M8 - Methods of Automatic Control

Current Lab Activities:

- (new) Signal generator with a 250 ohm resistor
- T/C module on SLC-500
- Analog module on an SLC-500
- UDC1200 setup and configure for manual and automatic mode
- (new) Have the students reset the parameters in the UDC1200 back to factory defaults
- Differential Pressure transmitter setup
- Calibrate temperature transmitter
- Manually control 2 proportional valves to set the level in the tank
- (New) PF525 controlled by a 4-20mA signal from an SLC-500
- (New) PF525 controlled by a 4-20mA signal from a ControlLogix
- Lab on wiring the control power on the Process Trainer

Proposed Modules in IND221 with Labs: (for Fall 2023 8B):

M1 - Introduction to Instrumentation Basics

(new) Signal generator with a 250 ohm resistor, and the signal generator used to change the intensity of the light bulb using a proportional controller

M2 - P&ID Diagrams and Single-Loop Controllers

UDC1200 setup and configure for manual and automatic mode

(new) Have the students reset the parameters in the UDC1200 back to factory defaults

M3 - PLC Controllers for Analog Control

T/C module on SLC-500

Analog module on an SLC-500

(New) PF525 controlled by a 4-20mA signal from an SLC-500

M4 - Controls on the Festo Process Trainer

Lab on wiring the control power on the Process Trainer

(New) PF525 controlled by a 4-20mA signal from a ControlLogix

M5 - Temperature Sensors & Controls

Calibrate temperature transmitter

M6 - Level Sensors & Controls

Manually control 2 proportional valves to set the level in the tank

M7 - Flow/Pressure Sensors & Controls

Differential Pressure transmitter setup

M8 - Methods of Automatic Control

Circuit setup to control level with a proportional valve, while monitoring the level and controlling the gate valve to drain tank.

## **Module 1: Introduction to Instrumentation Basics**

### ***Purpose:***

Introduce the student to analog signals and the reason th

### ***Topics covered:***

Discrete versus analog signals and voltages

24Vdc and 120Vac discrete input and output module wiring and devices

Analog signals, where they are used and what are the most common

Cabling and signal transmission basics

Purpose of a transmitter

2 and 4 wire transmitters (simulator and source)

Process Variable and Control Variable

How to use the Signal Generator to create a 4-20mA source

### ***Description:***

### ***Outcomes:***

1. Explain the difference between analog and digital signals
2. Compare the characteristics of a current analog signal and a voltage analog signal
3. Measure a 4-20 mA signal in an instrument circuit
4. Explain the termination of the wires of an instrument signal cable to instrument devices
5. Convert analog signals to a percentage and also to the process variable
6. Explain the purpose of an instrument transmitter in a process system
7. Wire a transmitter into an instrument circuit

### ***Hands-On Activities:***

Use the 4-20mA source to a 250 ohm resistor and measure the voltage drop across the resistor

Measure input impedance of an analog input module

Inject a signal using signal generator into an analog input channel and measure the voltage

Connect a transmitter to a 24Vdc P/S and to the input channel of a UDC1200

### ***Instructional Materials:***

Textbook Reading, Pages 293-300 Transmission Signals

## **Performance Assessment #1 (after M2 is complete)**

Setup the UDC1200 and manually control the output signal to control the light intensity

Manually reset the UDC1200 to factory default settings

Reset the UDC3300 to factory default settings

Calibrate an Acromag 250T transmitter

Connect a transmitter to a 24Vdc P/S and to the input channel of a UDC1200

**Performance Assessment #2 (after M4 is complete)**

Connect a T/C to the T/C module on an SLC-500 from an electrical print

Determine the address in the processor for the T/C

Connect an SLC-500 analog output to a PF525 VFD and control the speed with a program

Measure the analog signal going to the PF525

**Performance Assessment #3 (after M6 is complete)**

Wire the pushbutton controls for the Process Trainer

Calibrate the I/P converter on the process trainer

**Performance Assessment #4 (after M8 is complete)**

Calibrate the I/P converter on the process trainer

Load a project into the L5000 processor and the Panelview

Wire a control system based on the electrical prints and the P&ID

EEM162 (Aiken CC in SC)

1. Introduction to Process Control and Safety
2. Instrument Tags
3. Piping & Instrument Diagrams
4. Loop Controllers
5. Final Control Elements
6. Level Measurement
7. Liquid Level Control
8. Methods of Automatic Control
9. Basic Flow Measurement and Control
10. Control Loop Performance

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- M1 - Understanding the SLC-500 Analog Card
- M2 - Understanding the SLC-500 Thermocouple Card
- M3 - Understanding Universal Digital Controllers
- M4 - Familiarization with the Labvolt Trainer
- M5 - Understanding Pressure
- M6 - Understanding Level Control
- M7 - Understanding Flow
- M8 - Understanding Temperature

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Checking thermocouple with ohmmeter

[https://www.youtube.com/watch?v=3\\_lwLOuxr0Y&t=110s](https://www.youtube.com/watch?v=3_lwLOuxr0Y&t=110s)

Omega Engineering youtube channel

<https://www.youtube.com/user/OmegaEngineering1>

Some module 1 topics for IND221:

Review discrete signals for PLC inputs

Analog signals: 4-20mA, 1-5 Vdc, 0-10Vdc and 3-15 psi

Why use an offset on these analog signals?

% of range on an analog signal

How to calculate the signal based on percentage

Signal cable

250 ohm conversion, 4-20ma to 1-5 Vdc

What is a transmitter?

What is a sensor?