Module 1: Introduction to Instrumentation Basics

Topics covered:

Open loop and closed loop control
Discrete versus analog signals and voltages
Analog signals, where they are used and what are the most common
How a thermocouple works, and the different types of T/C
How to use a signal generator to simulate a T/C
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
Calibrate an Acromag 250T T/C transmitter

Module 2: P&ID Diagrams and Single-Loop Controllers

Topics covered:

Interpret the information within an Instrument Tag (Balloon on P&ID)
Determine the location of an instrument based on the Tag information
Interpret the P&ID diagrams
Overview of the UDC1200
Learn the basic operation of the UDC1200 trainer
Explain the basic operation of a proportional (SCR) heat controller
Determining the Unlock codes on the UDC1200
UDC1200 wiring diagram and terminal definitions
UDC 1200 in manual mode driving an output
Lookup parameter settings in the UDC1200 manual and quick reference sheets
UDC1200 in Automatic mode
Connect a mA meter in series with output to determine % out vs mA out

Performance Assessment #1 (after M2 is complete)

Interpret the components on a P&ID
Setup the UDC1200 and manually control the output signal to control the light intensity
Manually reset the UDC1200 to default settings (specified by the Instructor)
Calibrate an Acromag 250T transmitter for a specific temperature range
Connect a transmitter to a 24Vdc P/S and to the input channel of an analog input module (or 250 ohm resistor)
Change the setpoint on the UDC1200

Module 3: **SLC-500 PLCs for Analog Control**

Topics covered:

Review the SLC-500 hardware and how to use RSLogix500 software
Setup communication from computer to processor with RSLinx
Interpreting the wiring terminal diagram from vendor manuals for T/C and AIO modules
Interpret the vendor terminal diagram and configuration information for the Thermocouple module
Determine the data and configuration addresses for thermocouple module
Connect a thermocouple or thermocouple simulator (signal generator)
Differentiate between the 1746-NIO4V and NIO4I found in the PLC lab
Interpret the switch configuration on the analog I/O module
Determine the data value range for a specific analog signal, input or output
Single-ended versus differential analog input channel wiring
Determine the data and configuration addresses for an analog IO module
Convert a 4-20mA signal value into a digital vale
Use the SCP instruction in the SLC-500 to scale to engineering units
Calculate the analog signal output based on a digital value in the SLC-500 processor

Module 4: **Allen Bradley ControlLogix with Analog Control**

Topics covered:

Go over all the hardware on the ControlLogix Training unit
Identify and explain the communication ports on the ControlLogix system
Setup drivers in RSLinx to communicate with the ControlLogix processor
Determine if the analog input/output modules are wired for voltage or current
Remove/Insert modules and processor on a ControlLogix system
Interpret the information on the scrolling displays on the processor and ethernet module
Interpret the processor diagnostic indicators
Remove/replace removable terminal blocks from the I/O modules
Use RSLinx to determine firmware version of the processor
Create a new project using Logix Designer
Configure the I/O in the project based on the modules in the chassis
Create Alias Tags from the base Tags
Create a ladder logic routine in Logix Designer
Configure the analog modules in the ControlLogix system
Use potentiometers on the ControlLogix trainer to change the analog signal coming into AIN

Performance Assessment #2 (after M4 is complete)

Configure a thermocouple module on the SLC-500 training unit
Verify the T/C module configuration by simulating a T/C with the signal generator
Configure and set up an analog I/O module on the SLC-500 training unit.

Create a ControlLogix project configuring I/O and creating a ladder program
Configure the ControlLogix analog input module (1756-IF8)
Verify the configuration by injecting a 4-20mA signal into an analog input channel

Module 5: **Introduction to the Festo/Labvolt Process Trainers**

Topics covered:

Introduction to the components on theFesto/Labvolt Process Trainers
Connecting a flow loop with components on the Process Trainer
Connecting an E-Stop to the electrical circuit on the Process Trainer
Connecting the air source to training unit
Resetting the PF40 VFD to factory defaults
Control the start/stop/pump speed with the potentiometer on the PF40
Change the speed reference parameter to be controlled by a 4-20mA signal
Control the pump speed with a signal generator controlling the PF40
Measure the output pressure on the pump
Read and interpret the Rotameter
Calibrate the I/P converter on the control valve (signal generator and pressure gauge)

Module 6: **PLC and HMI Controls on the Process Trainers**

Topics covered:

Ping the different Ethernet devices on the process trainer (Ethernet module, HMIs & VFDs)
Load .ACD project into the ControlLogix processor
Load .MER file into the Panelview 1000 HMI
Using Logix Designer to load and monitor a ControlLogix Project
Determine the firmware level of the ControlLogix controller
Purpose of FactoryTalk View Studio to develop and HMI project
Purpose of FactoryTalk Machine Edition for loading a project into a PV1000
Using FactoryTalk Machine Edition to run the HMI Project on a computer
Ethernet control of the PF40 VFD and tags created in the .ACD project
Controlling the start/stop and speed of the PF40 with the HMI
Fluid circuit through the control valve
Control the opening of the control valve with manual control on the HMI
Introduce the PID instruction in the PLC project
Calibrate the I/P on the Control Valve
Connect the Control Valve to an analog output channel on the PLC unit
Manually control the position of the Control Valve with the HMI, and view the position
Connect a flow circuit similar to M5 and add the control valve
View the PID instruction in the PLC program and explain how it operates
Measure the pressure drop across the Control Valve while varying the fluid flow

Performance Assessment #3 (after M6 is complete)

Calibrate the I/P converter on the green control valve
Reset the PF40 VFD to factory defaults, and disable the reverse key
Control the speed of a PF40 with a 4-20mA signal from a signal generator
Configure the PF40 with Ethernet and control with the HMI
Connect the Control Valve to an analog output channel and control manually with the HMI
Connect a flow loop and control with the HMI and manual hand valves

Module 7: Flow/Pressure Sensing and Control Basics

Topics covered:

Flow sensors used in the process industry
Smart Transmitters
Differential Pressure Transmitters
Venturi Tube, orifice plate, paddlewheel flow sensor, rotameter with
3 valve manifold to connect smart transmitter
Rotameter with Reed switch
Laminar versus Turbulent flow
Connecting a circuit to control flow with the control valve
Calibrate the Smart Transmitter to the venturi tube
Learn basics on the Gain, Rate and Reset
Measure Pressure Drop across the Control Valve
Measure the Pressure Drop across the Venturi Tube
Connecting a circuit flow loop with the control valve
Measure air pressure in a pressurized water column using the digital pressure gauge
Measure the pressure drop across the venturi tube with different flow rates
Measure the pressure drop across the high and low pressure ports on the venturi tube
Calibrate the Smart Transmitter to measure flow and connect to venturi tube
Tune the parameters (gain, integral & derivative) of the flow loop
Create an interruption by restricting the flow with a hand valve to see the loop response
Calculate the flow rate based on differential pressure and compare to the rotameter

Module 8: Level Sensing and Control Basics

Topics covered:

Connecting a level circuit using hydrostatic pressure to measure level
Measure the hydrostatic pressure of the tank, both empty and full
Calibrate the DP to measure level
Connect DP to analog input channel 0
Connect CV to analog output channel 0
Tune the loop to respond to interruptions such as cracking a hand valve
Connect a second control valve between bottom of column and the tank
Control CVfill with HMI in manual mode and CV drain with a signal generator

Measure the CVfill response as the CV drain is opened more, draining more water
Connect the CV drain to analog output channel 1 to control with HMI in manual mode (50-100%)
Measure the response of CV fill as CV drain drains more water

Performance Assessment #4 (after M8 is complete)

Connect a flow loop using a venturi tube and DP transmitter
Connect a level loop using a DP transmitter, calibrated for level
Connect the control valve to analog output channel 0
Connect the DP transmitter to analog input channel 0, and a 24 Vdc supply
Tune the level loop with the parameters on the HMI