**MECH 1003/PTEC 1113**
**INTRODUCTION TO INDUSTRIAL TECHNOLOGY**

Original Course Description:
Co-requisite: BSTD 0603, MATH 1073 with BSTD 0071. This is the introduction to industrial plant reliability and operations. Emphasis is on local chemical, wood, water, power and manufacturing industries. Reliability topics include tools and industrial electrical, mechanical and automated predictive, planned, preventative, and reactive maintenance and documentation. Operations topics include process technician responsibilities; plant organization; process and utility equipment, systems and instrumentation; as well as quality, safety, and troubleshooting. This course is a merger of MECH 1003 FUNDAMENTALS OF INDUSTRIAL TECHNOLOGY and PTEC 1113 INTRODUCTION TO PROCESS TECHNOLOGY, and satisfies the requirements of both.

## *Overview of the four modules based on the Process Industry:*

***Note*:** Based on a discussion between Dave Carty and Tom Wylie on 5/24/22, it was determined that these 4 process modules will focus on the following:
**M1**: Students will learn what the process industry is, and will research 2 process companies in the area and create a report for the Instructor and other students. They will also get an overview of the four training units that will be used in the process technology program at South Ark CC.
**M2**: The students will get a more in depth understanding of the Distillation Process training unit and the process equipment/components that is used on the training unit, as well as the equivalent symbols that will be used on a Piping & Instrument Diagram. Student learning will be supported by student assignments in Part 4 of the text-book. Students will also be responsible to learn basic process technologies based on Part 1 of the text-book (ie. waste water, chemical industry and oil & gas).
**M3**: The students will learn how a process system works, which will be based on the Distillation Process training unit at South Ark CC. Students will be required to start, operate, and explain how the system works. Students will also be responsible to learn basic process technologies based on Part 1 of the text-book (ie. waste water, chemical industry and oil & gas).
**M4**: The students will learn what a Process Technician must be able to do on the job. This training will be on the HotSkid training unit at South Ark CC. Students will learn basic tasks at the control console of the HotSkid unit, and also within the actual HotSkid unit (outside). Students will learn how to follow a Standard Operating Procedure (SOP), as well as document the process and communicate with other personnel from remote locations. Students will also be responsible to learn basic process technologies based on Part 1 of the text-book (ie. waste water, chemical industry and oil & gas).

Dave & Tom met on 6/20/22 from 10:00 am-11:45 am CDT to discuss the process module.
**In module 1**, Dave would like to cover 3 primary areas:

1. Have the students get an understanding of the different process industries in the SACC service area (example: mining, pharmaceuticals, chemical, etc.). Dave will have to determine the readings from the textbook (possibly the summary at the end of the appropriate chapters). From there the students will perform a job description assignment, that will review 3 job descriptions (process operator, industrial maintenance, and electrical & instrumentation), then fill out a form asking about information on each type of job. This will be turned in.
The students will also be introduced to 6 different process training units. Dave will create a short video on each, the students will view from their devices. The HOA will be based on this.
Dave would like to have 4 HOAs, one for each of the 4 process modules as listed in the chart below in the right column. Each module will also have a KAA.
**In module 1**, Dave plans on creating a short video on each of the 6 process training units, then in the HOA, the student will have to determine what the unit is, and write a brief description of what it does.
**In module 2 HOA**, the students will identify the components on the Distillation Trainer by correlating the device on the diagram, to the actual device on the Trainer. Dave will have to do some PPTs to explain the difference between the different valves.
**In module 3 HOA**, the students will use the P&I diagram to draw the flow of fluid between the different points in the process, using a highlighter, and also to explain the different devices the fluid encounters in the path. (example: main tank to inlet to distillation column, bottom of distillation column back to the water tank, and from evaporation at the top of the distillation column to the alcohol tank.
**In module 4 HOA**, the students will work in a team of two on the HOT skid unit, with each person exchanging the other's role. One person will be on the control console and manually cycle a valve to 5 different positions (0%, 25%, 50%, 75% and 100% open). The other student will log the valve position and fill out an SOP form, while the 2 communicate on a radio.

## **Recommendation for 4 modules for the PTEC section of Intro to Technology**:

1. Local Process and Manufacturing Industries
2. Equipment and Fittings (Process Equipment Components & Symbols)
3. Instrumentation and Systems (Process Systems & Operations)
4. Operations and Quality

## Module 1: Local Process and Manufacturing Industries

CLO1: Describe major local process industries including raw materials, major processes, and products.
Module Description: The students will learn about local companies in the SACC service area and what these companies produce, as well as the basics of their specific processes. Students will also learn about the requirements for specific technical jobs at these local companies, so they can see the types of skills required for a specific technical job. Students will also be introduced to

the six process control training units at SACC, and will learn their function and how they operate.

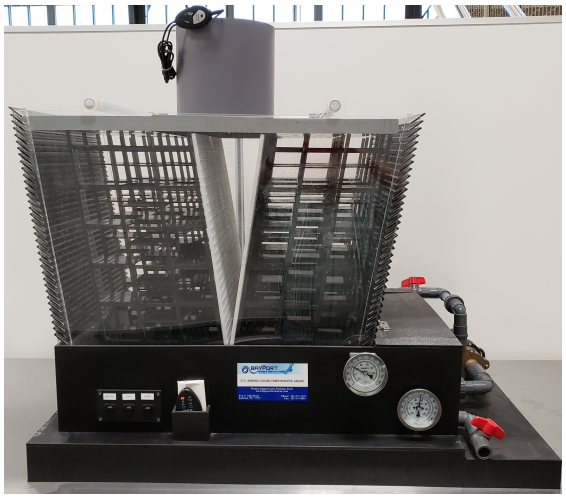
Upon completion of this module the student should be able to:

1. Categorize and list local process and manufacturing industries
2. Describe major processes used in each local industry
3. Describe products made in each local industry
4. Interpret job description skills requirements for Chemical Operators
5. Interpret job description skills requirements for Industrial Maintenance Technicians
6. Interpret job description skills requirements for Electrical & Instrumentation Technicians
7. Identify the 6 process training units at SACC
8. Explain what each of the 6 process training units operate at SACC
9. Explain the basics of the distillation process

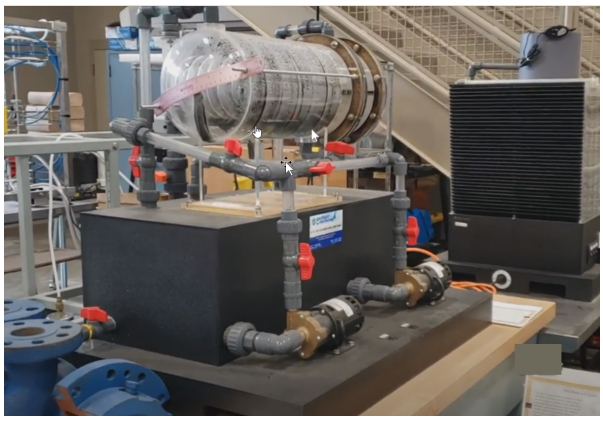
***Activities***:

1. Each student will acquire 3 job descriptions from job listings for local companies in the SACC service area, then determine the physical and skills requirement. Students will turn in a report on their findings.
2. Students will be required to identify the six different process control training units, and explain the purpose and operation of each unit.

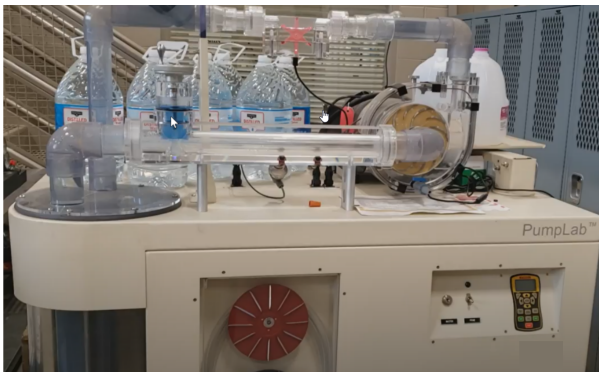
***Hands-on Training Units***:



Cooling Tower



Heat Exchanger




Pumps Trainer

Distillation Training Unit

HOT Skid Unit


Rankine Cycler

***Simulation:***

None.

***Instructional Materials***:

Hand-out of local industries, videos on the process trainers, online search, online videos, text or e-book, possible OER material, BlackBoard.

## Module 2: Equipment and Fittings

CLO4: Identify and describe function of basic process industry equipment (based on the Distillation Process training unit) such as pipe fittings, tanks, valves, pumps, heat exchangers, separators, reactors and utilities.

**Module Description**: This module will focus on the hardware used on standard process equipment, such as valves and piping. The students will learn all of the major components on the 6 different process training units at South Arkansas CC. A focus will be on the types of valves used in the process industry, as well as the types of pumps used in a fluid flow system. Students will also study the different types of pipe fittings and the different ways pipes are connected, as well as to identify if a valve is open or closed. Students will need to memorize the basic valve symbols for identification on a piping and instrumentation diagram.

**Module Outcomes**:

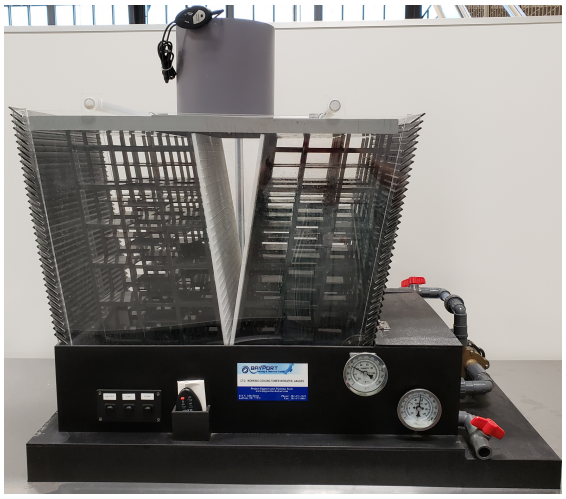
Upon completion of this module the student should be able to:

1. Identify basic process symbols from a Piping & Instrumentation Diagram
2. Categorize and describe common industry heat exchangers and cooling towers
3. Describe the basic operation of industry furnaces and boilers
4. Identify and describe function of common tanks, pipes, fittings, valves, pumps, compressors, and turbines.
5. Identify and describe function/purpose of common heat exchangers, separators, distillation units, furnaces, and chemical reactors.
6. Demonstrate ability to read Piping and Instrumentation Drawings (P&IDs) of the Distillation Process training unit.

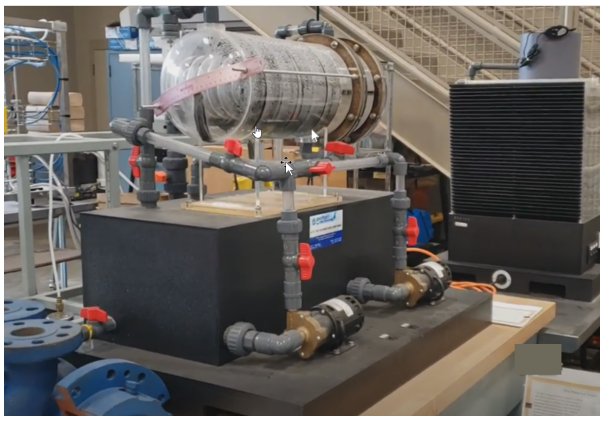
***Hands-on Activities***:

1. Identify all components on the Cooling Tower Training Unit
2. Identify all components on the Electric Plant (Rankine Cycler) Training Unit
3. Identify all components on the Distillation (Pignat skid) Training Unit
4. Identify all components on the Pump Lab (Centrifugal Pump) Training Unit
5. Identify all components on the Heat Exchanger (Shell & Tube) Training Unit
6. Identify all components on the HOT Skid Training Unit
7. Match P&ID icons with components on the Pignat Distillation Training Unit
8. Match designated tanks, pipes, fittings, valves, pumps, compressors, turbines, heat exchangers, and the distillation unit with P&ID icons and labels.

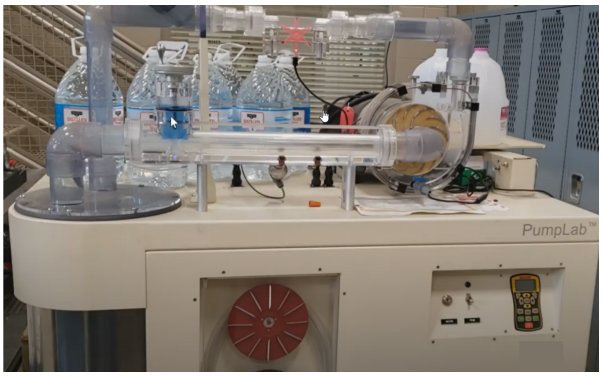
***Hands-on Training Unit***:



Cooling Tower



Heat Exchanger




Pumps Trainer

Distillation Training Unit

HOT Skid Unit


Rankine Cycler

***Instructional Materials***:
Videos created by the Instructor, and also create PPT and Voice over PPT learning objects for students to view in the Blackboard LMS.

## Module 3: Instrumentation and Systems

CLO5: Identify and describe basic instrumentation, operating controls, and systems.
Upon completion of this module the student should be able to:

**Module Description**: This module will focus on the hardware used on standard process equipment, such as valves and piping. The students will also learn about fluid pumps and the basic types used, especially on the Distillation Training unit.

**Module Outcomes**:
Upon completion of this module the student should be able to:
1. Explain how the distillation process works within a distillation column.

1. Identify and describe function of common tanks, pipes, fittings, valves, pumps, compressors, and turbines.
2. Identify and describe function/purpose of common heat exchangers, separators, distillation units, furnaces, and chemical reactors.
3. Demonstrate ability to read Piping and Instrumentation Drawings (P&IDs) of the Distillation Process training unit.

***Hands-on Activities***:
Record local and remote pressure, temperature, level, and flow values on operating equipment.
Calculate incremental tank volume and time required to change level at a given pump rate.
Perform cold start on a designated Simtronics Simulator module(s).

***Hands-on Training Unit***:


**Distillation System training unit at South Ark CC.**

***Simulation:***
None.
***Instructional Materials***:
Videos created by the Instructor, and also create PPT and Voice over PPT learning objects for students to view in the Blackboard LMS.
Students must read Chapter 24 on Distillation in the textbook (excellent explanation).

Distillation Process Explanation by Dave 052622

https://youtu.be/gTQRrzXgWR4

## Module 4: Operations and Quality

CLO2: Describe major process quality concerns and control practices.
CLO6: Describe and give examples of industrial reliability categories.
**Module Description**: This module will focus on the hardware used on standard process equipment, such as valves and piping. The students will also learn about fluid pumps and the basic types used, especially on the Distillation Training unit.
**Module Outcomes**:
Upon completion of this module the student should be able to:
1. Identify and describe function of common tanks, pipes, fittings, valves, pumps, compressors, and turbines.

2. Identify and describe function/purpose of common heat exchangers, separators, distillation units, furnaces, and chemical reactors.
3. Demonstrate ability to read Piping and Instrumentation Drawings (P&IDs) of the Distillation Process training unit.

Original: Upon completion of this module the student should be able to:
1. Describe typical hour, day, week, year activities/routine of local industrial technician.
2. Discuss union considerations.
3. Discuss typical industry organization/departments.
4. Describe the purpose of common industrial utilities: plant air, water, process sewer/WWTP, flare, nitrogen, natural gas, instrument air, steam, CW, CT, UPS.
5. Describe concepts of industrial quality and quality control.
6. Discuss soft skills required in local industries.

***Hands-on Activities***:
1. Follow SOP to start HOT skid and bring to steady parameter values as designated by instructor and report in the log book.
2. Record designated operating HOT skid parameter values in log book or log sheet.
3. Converse with the instructor via radio to set HOT skid flow rate.
4. Look up and report upper and lower control limit values for designated HOT skid parameters.
5. Role play with instructor a soft skill vignette.

***Hands-on Training Unit***:

**HOT Skid training unit at South Ark CC.**

Can design multiple simulations in Automation studio that will have the students perform the same functions online, as they are doing in the Hands-on Activities in the lab.

***Instructional Materials***:
Videos created by the Instructor, and also create PPT and Voice over PPT learning objects for students to view in the Blackboard LMS.

## *Overview of the four modules based on Industrial Technology:*

***Note*:** Initiated by Tom Wylie, but must be vetted through the SACC CTE Dean/Faculty to verify that it meets the needs of the SACC students:

**M5**: Students will learn about basic hand tools used in an industrial and process environment, as well as basic power tools. Basic fasteners such as screws, bolts, washers, etc. will also be discussed, as well as drill sizes. Students will also learn about linear measurement.

**M6**: The students will be introduced to basic electricity and its application in the industrial and process industries. Students will learn the basics of AC & DC current, as well as single and three phase applications. Student learning will be supported by students reading Chapter 19 of the text-book, and with OER materials that will supplement the text book. Students will experience electrical circuits with online simulations, as well as in the hands-on electrical labs where they will connect industrial components and circuits.

**M7**: The students will be introduced to fluid power (primarily pneumatic) circuits and systems found in industry. Students will learn the components of a circuit, as well as the symbols for the components found on a pneumatic circuit diagram. The module will conclude with a pneumatic circuit being controlled with an electrical circuit. Students will experience circuit operation through online simulations, as well as hands-on exercises in the advanced manufacturing lab. Student learning will be supported by PPT/PDF files and videos created by the faculty.

**M8**: The students will be introduced to control systems found in industry, primarily based on Programmable Logic Controller (PLC) technology. Students will learn the parts of a PLC system and how the program can be used to control a pneumatic circuit. The module will also show how PLCs are used in a process control system. Students will experience circuit operation through online simulations, as well as hands-on exercises in the advanced manufacturing lab. Student learning will be supported by PPT/PDF files and videos created by the faculty.

### Recommendation for 4 modules for the Industrial Technologies section of Intro to Technology:

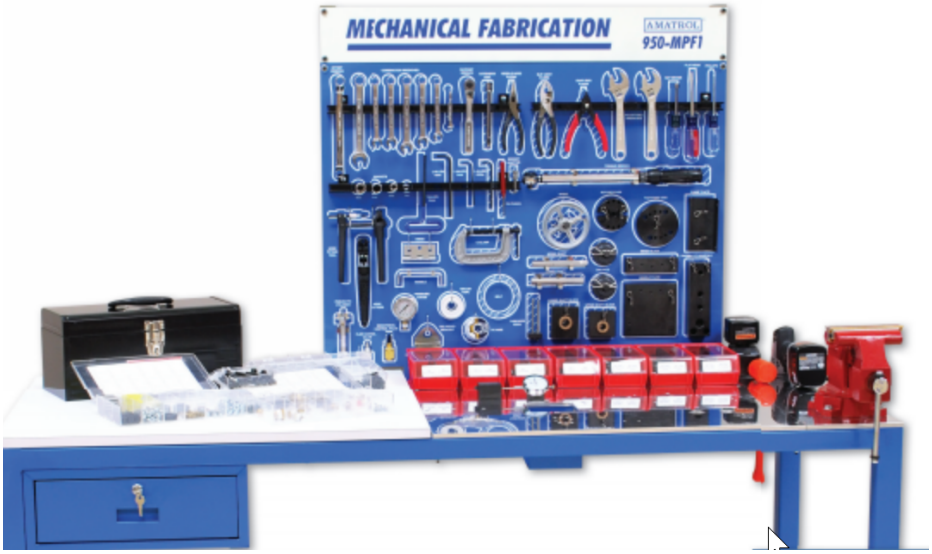
1. Industrial Tools & Fasteners
2. Electrical and Motor Basics
3. Fluid Power Basics
4. Industrial Control Circuits

### Module 5: Industrial Tools & Fasteners

CLO8: Apply basic industrial tools and mechanisms including: hand and power tools, mechanical components, measurement and unit conversions.
Upon completion of this module the student should be able to:
1. Identify basic hand tools used in an industrial environment
2. Identify basic power tools used in an industrial environment
3. Explain the operation of gears and other mechanical devices
4. Identify basic fasteners such as bolts, screws, washers and hangers
5. Perform linear measurements using a steel rule and tape measure
6. Convert linear measurements between metric and American units
7. More info coming for this module

***Hands-on Activities***:
1. Create a fabrication/assembly lab exercise, that would include sawing wood or aluminum, then drilling holes in wood or aluminum, then tapping holes in aluminum, then using various types of bolts, screws, nuts & washers to assemble with tools including allen wrenches. There may be commercial kits available that could be purchased in the bookstore. More research is needed on this.

***Hands-on Training Unit***:




**Mechanical Fabrication Training Unit at South Ark**

***Automation Studio Simulation:***
None.

***Instructional Materials***:
Possible OER material, and also create PPT and Voice over PPT learning objects for students to view in Blackboard.

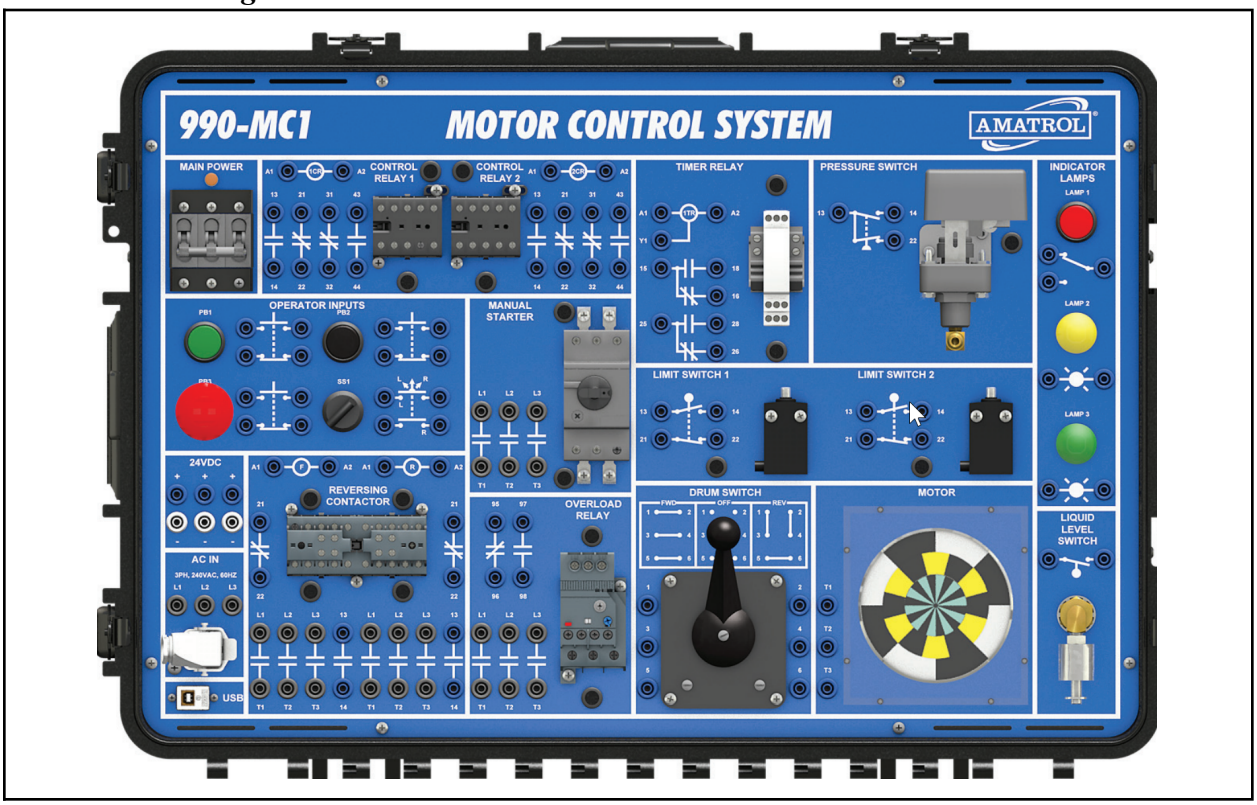
OER: Hand tools
https://www.wisc-online.com/learn/career-clusters/architecture-and-construction/sft5716/hand-tools
OER: Identifying hand tools by name quiz
https://www.wisc-online.com/learn/career-clusters/architecture-and-construction/sft5816/identifying-hand-tools-by-name

## Module 6: Electrical and Motor Basics

CLO9: Explain the operation of basic electrical components and circuits used in industrial and process applications.
B: The students will be introduced to basic electricity and its application in the industrial and process industries. Students will learn the basics of AC & DC current, as well as single and three phase applications. A heavy focus will be on measuring the resistance of pushbutton and relay contacts, as well as measuring the resistance of relay coils. Students will assemble basic relay circuits including a start/stop with hold-in circuit. Students will also be introduced to industrial motors and the voltages that power them. Students will experience electrical circuits with online simulations, as well as in the hands-on electrical labs where they will connect industrial components and circuits.
**Module Outcomes**:
Upon completion of this module the student should be able to:
1. Explain where AC and DC electricity is used in industrial and process environments
2. Explain the relationship between voltage, current and resistance in an electrical circuit
3. Calculate the current in a basic series circuit
4. Explain continuity and resistance when working with electrical components
5. Measure voltage, current and resistance in a simulation, or an actual circuit
6. Explain basic operation electrical control components on an electrical print
7. Measure the resistance and continuity of basic electrical control components
8. Assemble a basic relay circuit with start/stop and hold-in contact configuration
9. Explain the purpose of a GFCI and basically how it works
10. Explain the basic operation of a three-phase AC motor
11. Interpret the basic parameter of a three-phase AC motor from the nameplate
12. More info coming for this module

***Hands-on Activities***:
Use the Amatrol Motor Control and AC/DC training unit to:
Measure resistance with a DVM
Measure the resistance of a relay or motor starter coil
Measure voltage on DC and AC low voltage power supplies
Measure the continuity of N.O and N.C. pushbuttons
Setup a small circuit with pushbutton in series with a coil
Wire a start/stop relay circuit

***Hands-on Training Unit***:




**Motor Control Training Unit at South Ark CC**

***Automation Studio Simulation:***

Can design multiple simulations in Automation studio that will have the students perform the same functions online, as they are doing in the Hands-on Activities in the lab.

***Instructional Materials***:

Chapter 19 (Electricity and Motors) in the textbook

Possible OER material, and also create PPT/PDF and Voice over PPT learning objects for students to view in Blackboard.

## Module 7: Fluid Power Basics

CLO10: Explain the operation of basic fluid power components and circuits used in an industrial application.

**Module Description**: This module will focus on the student learning the basics on fluid power circuits (primarily pneumatic circuits) that are used in a manufacturing environment. Students will learn the symbols used in a pneumatic circuit print, and how they correlate to the actual devices used in the hands-on lab. The students will learn the basic operation of the circuits using Automation Studio (simulation) software. Students will utilize a 4/3, 5 port directional valve in a

single-acting cylinder, and dual-acting cylinder circuits. The students will also connect the circuit on the actual Pneumatics Instrumentation training unit in the SACC lab.

**Module Outcomes**:

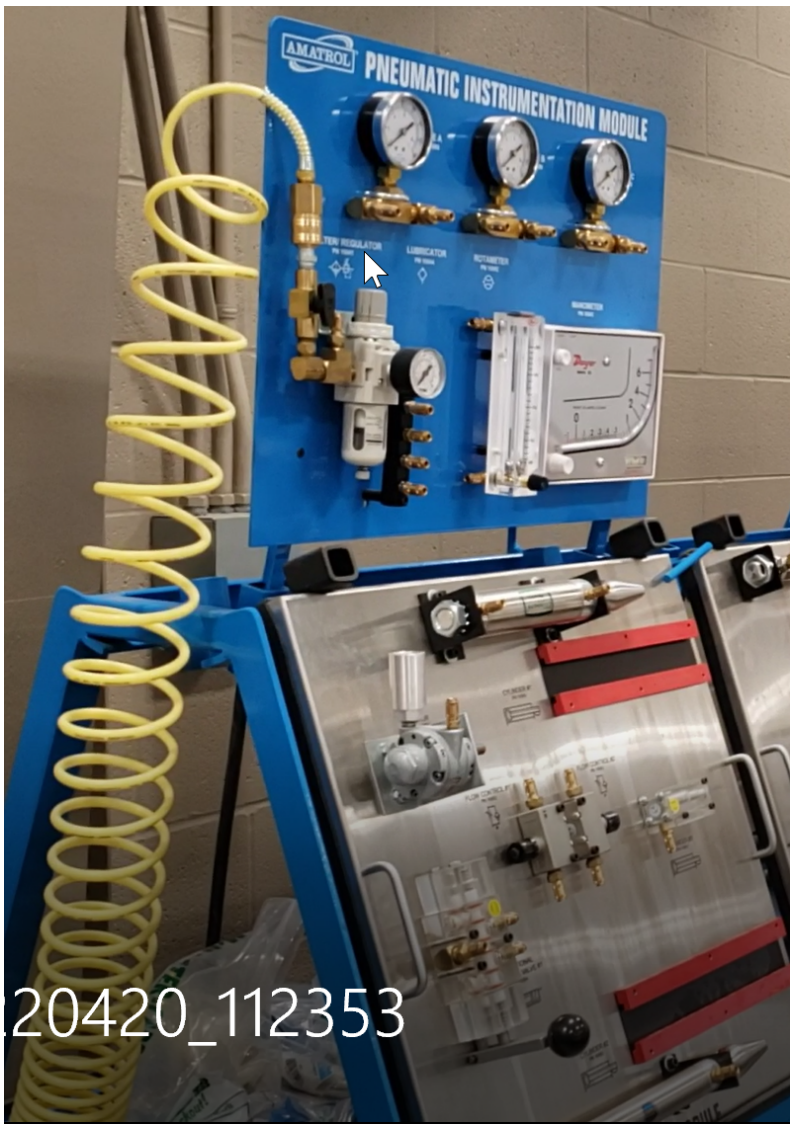
Upon completion of this module the student should be able to:

1. Explain the main components that will supply compressed air to a fluid power lab
2. Explain PSI, BARs, atmospheric pressure and gauge pressure in an air system
3. Convert PSI to BARs, and BARs to PSI
4. Explain the difference between a pneumatic and hydraulic system
5. Identify the symbols for exhaust, air supply, valve, flow control and valve on an air circuit
6. Explain what a check valve is, and what direction the air will flow through the valve
7. Identify the symbols of a single-acting and dual-acting pneumatic cylinder
8. Explain the operation of a single-acting and dual-acting pneumatic cylinder
9. Explain how a unidirectional flow valve works in a circuit

***Hands-on Activities***:

Measure incoming pressure on compressed air feedline
Connect a circuit with a manual 4/3 valve running a single acting cylinder
Measure pressures at various nodes in the pneumatic circuit
Connect a circuit with a manual 4/3 valve running a dual acting cylinder
Measure pressures at various nodes in the pneumatic circuit
Correlate the symbols on a pneumatic print to the actual components in the circuit

***Hands-on Training Unit***:




**Pneumatics Training Unit at South Ark CC**

***Automation Studio Simulation:***
Can design multiple simulations in Automation studio that will have the students perform the same functions online, as they are doing in the Hands-on Activities in the lab.

***Instructional Materials***:
Possible OER material, PPT/PDF, videos created by the instructor, and Voice over PPT learning objects for students to view in Blackboard.
Also, Automation Direct Pneumatics eBook (free download):
https://www.automationdirect.com/ebooks/pneumatics-handbook

OER: Pneumatic power supply

https://www.wisc-online.com/learn/career-clusters/stem/hyp4507/pneumatic-power-supply

## Module 8: Industrial Control Circuits

CLO11: Explain the basic operation of control circuits used in industrial and process environments.

**Module Description**: This module will focus on the student learning the basics of industrial and process control circuits, which will include electrical, discrete PLC and PLC analog control circuits. Students will learn how electrical circuits can be used to control a pneumatic circuit, in a continuous operation using proximity switches. Students will also learn the basic operation of an industrial PLC system, both in an online simulation, and on a CompactLogix system. A special focus will be on the correlation between the PLC I/O indicator lights, the corresponding terminal voltage, and the effect on the PLC program that is running a system. Students will also be introduced to basic analog control systems, focusing on the components used on the South Arkansas HOT Skid training unit.

**Module Outcomes**:

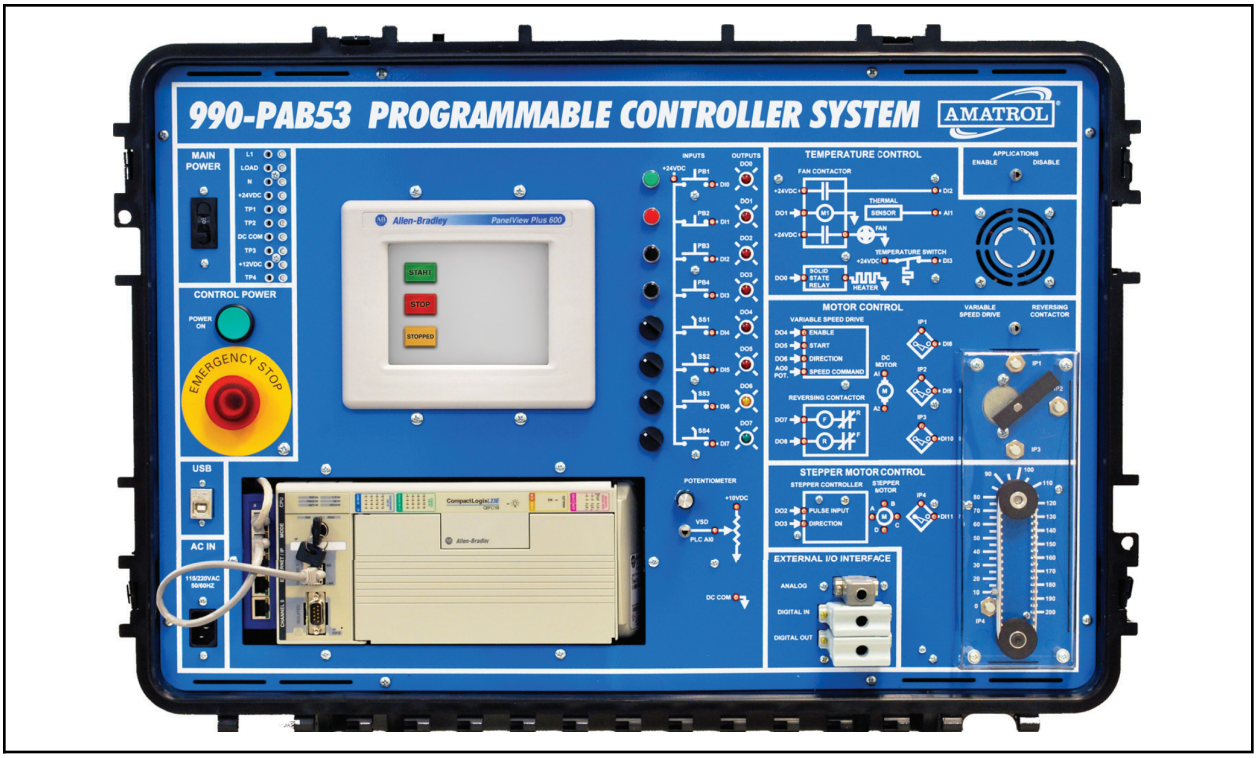
Upon completion of this module the student should be able to:

1. Identify and explain each component on the pneumatic and electrical print
2. Explain the purpose of a proximity switch on a pneumatic circuit
3. Explain how the electrical control circuit works to control a 4/2 pneumatic circuit
4. Explain how a PLC control circuit works to control a 4/2 pneumatic circuit
5. Explain the basic hardware and operation of a PLC system
6. Explain what turns on the indicator lights on PLC input & output modules
7. Explain how the PLC control circuit works to control the 4/2 valve
8. Identify the components on a basic instrument loop in a process system
9. Explain where analog signals (4-30mA and 3-15 psi) is used on a process system
10. Interpret the I/O indicators on a CompactLogix PLC system

***Hands-on Activities***:

Online Simulation to use an electrical circuit to control a pneumatic circuit
Online Simulation to use a PLC circuit to control a pneumatic circuit
Online Simulation to operate a ControlLogix PLC to run a pneumatic circuit
Test terminal voltages on the online CompactLogix simulation
Interpret the I/O indicators and processor diagnostic indicators on a CompactLogix PLC
Measure voltages at I/O terminals on a CompactLogix PLC

***Hands-on Training Unit***:




**PLC Training Unit at South Ark CC**

***Automation Studio Simulation:***

Can design multiple simulations in Automation studio that will have the students perform the same functions online, as they are doing in the Hands-on Activities in the lab.

***Instructional Materials***:

Possible OER material, PPT/PDF, videos created by the instructor,  and Voice over PPT learning objects for students to view in Blackboard.