

Penn Foster's Instrumentation and Process Control Technician

Base Program			
Course Title	Course Number	PF Price	Course Duration
Year 1:			
Temperature Measurement	186127	\$75.00	5 hours
Fluid Measurement	186129	\$75.00	5 hours
Introduction to Print Reading	186325	\$75.00	8 hours
Electrical Drawings and Circuits	186044	\$75.00	8 hours
Electronic Drawings	186045	\$75.00	8 hours
Basic Semiconductor Components: Diodes	086019	\$75.00	6 hours
Basic Semiconductor Components: Transistors	086020	\$75.00	6 hours
Switching Devices	086021	\$75.00	6 hours
Electronic Sensors	086022	\$75.00	6 hours
Electronics Hardware	086040	\$75.00	6 hours
Reactive Circuits	Block B22	\$225.00	15 hours
Reactance and Impedance	086037	(\$75.00)	(5 hours)
Resonant Circuits	086038	(\$75.00)	(5 hours)
Applications and Troubleshooting of Resonant Circuits	086039	(\$75.00)	(5 hours)
Basic Electronic Circuits	Block B24	\$600.00	48 hours
Rectifiers and Power Supplies	086041	(\$75.00)	(6 hours)
Amplifiers	086042	(\$75.00)	(6 hours)
Oscillators	086043	(\$75.00)	(6 hours)
Modulation and Detection Circuits	086044	(\$75.00)	(6 hours)
Switching Circuits	086054	(\$75.00)	(6 hours)
Logic Circuits	086055	(\$75.00)	(6 hours)
Gating and Counting Circuits	086056	(\$75.00)	(6 hours)
Pulse and Digital Circuits	086057	(\$75.00)	(6 hours)
Electronic Systems	Block B25	\$***.00	** hours
Electronic Devices and Amplification	086045	(\$75.00)	(6 hours)
Audio and RF Circuits	086046	(\$75.00)	(6 hours)
Oscillators, Feedback, and Waveforms	086047	(\$75.00)	(6 hours)
Year 2:			
Electronic Power Supply Systems	086048	(\$75.00)	(6 hours)
Industrial Amplification Systems	086058	(\$75.00)	(6 hours)
Servo and Control Systems	086059	(\$75.00)	(6 hours)
Pulse and Logic Circuits	086060	(\$75.00)	(6 hours)
Programmable Controllers and Microprocessors	086061	(\$75.00)	(6 hours)
Industrial Electronic Troubleshooting	086064	\$75.00	6 hours
Troubleshooting Sensing Devices and Systems	086066	\$75.00	6 hours
Troubleshooting Industrial Control Systems and Output Devices	086067	\$75.00	6 hours
Troubleshooting Industrial Computer Systems and Software	086068	\$75.00	6 hours
Industrial Computer Networks	086069	\$75.00	6 hours
Basic Industrial Computer Systems	Block B10	\$375.00	35 hours
Industrial Computer Fundamentals	B1001	(\$75.00)	(7 hours)
Digital and Analog Systems	B1002	(\$75.00)	(7 hours)
Software and Programming	B1003	(\$75.00)	(7 hours)
Progress Examination	B1021	(\$0.00)	(0 hour)

Computer-Aided Control Systems	B1004	(\$75.00)	(7 hours)
Interfacing Principles	B1005	(\$75.00)	(7 hours)
Progress Examination	B1022	(\$0.00)	(0 hour)
Progress Examination Booklet	B1020	(\$0.00)	(0 hour)
Digital Electronics (replaces Blocks B07, 08 & 09)	086E18	\$525.00	60 hours

Year 3:

Introduction to Microprocessors	Block B11	\$300.00	28 hours
Introduction to Computers	B1101	(\$75.00)	(7 hours)
Introduction to Microprocessor Applications	B1102	(\$75.00)	(7 hours)
Microprocessor Basics, Part 1: Underlying Principles and Concepts	B1103	(\$75.00)	(7 hours)
Microprocessor Basics, Part 2: Overview of What's in a Microprocessor	B1104	(\$75.00)	(7 hours)
Progress Examination	B1121	(\$0.00)	(0 hour)
Progress Examination Booklet	B1120	(\$0.00)	(0 hour)
PLC Technology	086E21	\$385.00	60 hours
Industrial Electronic Circuit Applications	Block B14	\$375.00	35 hours
Interfacing Process Variables	B1401	(\$75.00)	(7 hours)
Motor Control and Servo Systems	B1402	(\$75.00)	(7 hours)
Numerical Control Systems	B1403	(\$75.00)	(7 hours)
Progress Examination	B1421	(\$0.00)	(0 hour)
Programmable Controllers	B1404	(\$75.00)	(7 hours)
Industrial Robots	B1405	(\$75.00)	(7 hours)
Progress Examination	B1422	(\$0.00)	(0 hour)
Progress Examination Booklet	B1420	(\$0.00)	(0 hour)
Advanced Troubleshooting Techniques	Block B16	\$***.00	42 hours
Approach to Troubleshooting	B1601	(\$75.00)	(7 hours)
Analysis of Systems	B1602	(\$75.00)	(7 hours)
Test Equipment Applications	B1603	(\$75.00)	(7 hours)
Progress Examination	B1621	(\$0.00)	(0 hour)
Safe Troubleshooting Practices	B1604	(\$75.00)	(7 hours)

Year 4:

Troubleshooting Industrial Systems, Part 1	B1605	(\$75.00)	(7 hours)
Troubleshooting Industrial Systems, Part 2	B1606	(\$75.00)	(7 hours)
Progress Examination	B1622	(\$0.00)	(0 hour)
Progress Examination Booklet	B1620	(\$0.00)	(0 hour)
Distributed Control Systems, Part 1	086084	\$75.00	10 hours
Distributed Control Systems, Part 2	086085	\$75.00	10 hours
Distributed Control Systems, Part 3	086086	\$75.00	10 hours
Pneumatic Instrumentation for the Technician	286M01	\$395.00	35 hours
Control Technology for Technicians	286M04	\$525.00	45 hours
Electronic Process Control	086E17	\$545.00	30 hours

Estimated Total Curriculum Duration: 605 hours (Yr. 1 = 147 hrs; Yr. 2 = 153 hrs; Yr. 3 = 151 hrs; Yr. 4 = 154 hrs)

Cost: Yr. 1 = \$1,725.00 + s/h; Yr. 2 = \$1,650.00 + s/h; Yr. 3 = \$1,360.00 + s/h; Yr. 4 = \$1,840 + s/h)

Number of Exams: 77

186127

Temperature Measurement

Objectives:

- Change temperature units from one system to another.
- Discuss the use of the various types of thermometers.
- Select the type of thermometer to be used at certain temperatures.

186129

Fluid Measurement

Objectives:

- Understand the properties of fluids.
- Determine the density, specific gravity, and viscosity of fluids.
- Express pressure in three different units.
- Measure the pressure of fluids using manometers and Bourdon tube pressure gauges.
- Measure the flow rate of fluids using different types of flowmeters.

186325

Introduction to Print Reading

Objectives:

- Identify the various kinds of lines used on drawings.
- Compare and contrast the various types of drawings.
- Relate the information given in the title block and bill of material to the drawing.
- Define different types of scales used on drawings.

186044

Electrical Drawings and Circuits

Objectives:

- Identify electrical construction drawings, schematics, and wiring diagrams.
- Interpret various electrical symbols.
- Read standard abbreviations used in electrical diagrams.
- Tell if a diagram is a block diagram, a schematic diagram, or a wiring diagram.
- Compare closed circuits, open circuits, grounded circuits, and short circuits.

186045

Electronic Drawings

Objectives:

- Identify and interpret the various electronics symbols used on drawings.
- Identify and interpret the various types of drawings used in the electronics field.

086019

Basic Semiconductor Components: Diodes

Objectives:

- Describe how diodes work in a rectifier and how to determine if they are working properly.
- Explain how different types of diodes function.
- List a variety of diode uses in electronic systems.
- List the characteristics that make a particular diode useful in a given situation.
- Know how a diode works with other components in an electronic circuit.
- Perform basic measurements in diode circuits, that will assist in troubleshooting tests.
- Select a proper diode for replacement in a circuit.

086020

Basic Semiconductor Components: Transistors

Objectives:

- Learn how transistors control the flow of electricity in a circuit.
- Describe the construction of bipolar transistors.
- Explain how the operation of bipolar transistors resembles that of the diode.
- Discuss how bipolar transistors can control and amplify current in a circuit.
- Describe the construction and operation of JFETs and MOSFETs.
- How to use an ohmmeter to perform basic tests on bipolar transistors.
- Perform basic troubleshooting measurements and calculations on circuits that contain amplifying devices.

086021

Switching Devices

Objectives:

- Learn how a switch changes:
 - voltage levels and current levels.
 - the DC polarity of the delivered voltage.
 - the direction of direct current.
 - from one delivered frequency to another.

- Describe how the above functions can be performed by mechanical switches or by electronic circuitry.
- List the advantages and disadvantages of various switch types and how they function..
- Analyze basic relay ladder diagrams.
- Explain how a diode can be used as a switch.
- Name some of the problems of diode switching.
- Describe how very rapid electronic switching is accomplished.
- Explain the circumstances in which a mechanical switch may be preferable to a rapid electronic switch.

086022

Electronic Sensors

Objectives:

- Learn how certain electronic components are used as sensors and as parts in control mechanisms.
- Explain what sensors and transducers do.
- Describe important thermoelectric effects.
- Learn how these types of transducers operate and the effects they cause; electromagnetic, electroacoustical, piezoelectric, photoelectric, and electromechanical.
- Explain the importance of a bridge circuit in certain types of electronic instrumentation.
- Describe how certain nonlinear resistors are used in circuits.
- Explain how certain components can be used as protection devices for circuits.
- Define the scientific terms stress and strain.

086040

Electronics Hardware

Objectives:

- Learn the uses and applications of these components that are critical to the repair and maintenance of an analog circuit or system: fasteners, connectors, jacks, component sockets, cables, strain gages, relays, wires, heat shrink tubing, batteries and UPSs.
- How to construct a circuit board for a personal computer.
- Learn correct and safe soldering techniques.
- Understand surface mount technology.

Block B22

Reactive Circuits

Duration:

15 hours (includes 3 tests)

Course Prerequisites:

Basic Industrial Math (Block X21)

Analog Circuit Measurement (Block A23)

What Students Learn:

This block explains how electronic circuits, resistors, capacitors and inductors, work in DC and AC circuits. Methods for determining impedance, reactance and phase angle are introduced. The student will learn to recognize the resonant circuit condition and understand how these special circuits are used. Resonant circuit applications such as coupled circuit traps, filters and transmission lines are discussed. The student's troubleshooting skills are expanded. The proportional method of estimating voltage is covered. The concepts of impedance matching and maximum power transfer are explained.

Special Notes:

This updated course replaces Reactive Circuits, Block B02. Each study unit contains a progress exam.

Components:

Reactance and Impedance (086037)

Resonant Circuits (086038)

Applications and Troubleshooting of Resonant Circuits (086039)

086037

Reactance and Impedance

Objectives:

- Define capacitive and inductive reactance.
- Explain how resistors, capacitors and inductors work in DC circuits.
- Calculate time relationships in circuits.
- Determine reactive and impedance values for series and parallel AC circuits.
- Calculate the values of voltage, current, and impedance in RC, RL, and RLC circuits.
- Determine the voltage-current phase angle relationships in capacitive and inductive circuits.
- Work with J operators to analyze circuit behavior.

086038

Resonant Circuits

Objectives:

- Recognize the conditions required for series and parallel resonance.
- Cite the factors affecting capacitive reactance and inductive reactance in series and parallel circuits.
- Determine the resonant frequencies of LC series and LCR parallel circuits. • Calculate the value of the quality (Q) factor and bandwidth of a circuit..
- Describe the relationship between Q and bandwidth.
- Describe the practical uses for tuned circuits.

086039

Applications and Troubleshooting of Resonant Circuits

Objectives:

- Learn how to estimate voltage for troubleshooting AC and DC circuits.
- Explain the need for impedance matching and how it is accomplished. • Identify the circuits for low-pass, high-pass, band-pass, band-reject and power-supply filters.
- Interpret a filter's characteristic curve.
- Determine cut-off frequency for various filters.
- Select the particular type of series or parallel-tuned circuit for certain applications.
- Explain how transmission lines are related to resonant circuits and waveguides.
- Explain how transmission lines are used as components in tuned circuits.

Block B24 Basic Electronic Circuits

Duration:

48 hours (includes 8 tests)

Course Prerequisites:

Basic Industrial Math (Block X21)
Analog Circuit Measurement (Block A23)
Analog Electronic Components (Block B23)

What Students Learn:

This block describes how components are grouped in industrial electronic circuits to perform particular functions or achieve certain circuit characteristics. The trainee will learn how power is supplied to and rectified for use in electronic equipment. The block also explains how signals are produced, transmitted, received, evaluated, and utilized in common industrial electronic applications. Biasing, circuit parameters, component selection (value and rating), and the respective advantages / disadvantages of each are covered.

Special Notes:

This updated course replaces Basic Electronic Circuits, Block B04. Each study unit contains a progress examination.

Components:

Components:

Rectifiers and Power Supplies (086041)
Amplifiers (086042)
Oscillators (086043)
Modulation and Detection Circuits (086044)
Switching Circuits (086054)

Logic Circuits (086055)
Gating and Counting Circuits (086056)
Pulse and Digital Circuits (086057)

086041 Rectifiers and Power Supplies

Objectives:

- Identify the basic types of rectifiers.
- Discuss the operation of various power supply filters.
- Cite the advantages for different rectifier connection schemes.
- Determine the values for a voltage divider.
- Explain how voltage dividers are used in power supplies.
- Determine the current through, and voltage across, nonlinear components, such as diodes.

086042 Amplifiers

Objectives:

- Indicate the advantages of various classes of transistor amplifier operation.
- Calculate the dB gain of an amplifier circuit.
- Identify the several types of transistor amplifier circuits.
- Show the proper polarity for NPN and PNP transistor connections.
- Explain the methods used for biasing a transistor.
- Describe the types of distortion introduced by amplifiers.
- Explain how to troubleshoot amplifiers.

086043 Oscillators

Objectives:

- Explain the differences between several types of oscillator circuits.
- Identify the feedback components of an oscillator circuit, including LC and RC types.
- Describe the flywheel effect and how it is produced.
- Indicate the principle difference between various oscillator circuits.
- Calculate the resonant frequency of an oscillator circuit.
- Describe the effects of temperature on crystal oscillators.
- Discuss various applications of oscillator circuits.
- Describe how a frequency synthesizer works.

086044

Modulation and Detection Circuits

Objectives:

- Describe the various types of detector circuits.
- Explain the various forms of modulation.
- Calculate bandwidth of signals.
- Determine the frequencies resulting from combining or mixing two signals.
- Describe the advantages and disadvantages of pulse code modulation.
- Explain the operation and applications of phase locked loops.
- Indicate applications of detector and modulation circuits.

086054 Switching Circuits

Objectives:

- Match the output conditions for various gate circuits.
- Show how transistors are used as logic gates.
- Discuss the operation of flip flops.
- Name the applications of registers and memories.
- Indicate the proper output for a specific multivibrator circuit.

086055 Logic Circuits

Objectives:

- Work with number systems.
- Indicate the use of encoders and decoders.
- Convert decimal numbers to binary and hexadecimal numbers.
- Develop truth tables.
- Explain how adders, subtractors, and comparators are used.

086056 Gating and Counting Circuits

Objectives:

- Cite the use of arithmetic logic gates.
- Work with half-adder and full-adder circuits.
- Discuss the use of subtractor circuits.
- Identify the applications for decade and binary counters.
- Determine the modulus of a counter.

086057 Pulse and Digital Circuits

Objectives:

- Indicate the basic parts of a pulse waveform.
- Identify the difference between limiter and clamper circuits.
- Calculate the time constants for integrating and differentiator circuits.
- Describe the action of trigger circuits.
- Work with binary numbers.

Block B25 Electronic Systems

Duration:

48 hours (includes 8 tests)

Course Prerequisites:

Basic Industrial Math (Block X21)
DC Principles (Block A21)
Basic Electronic Circuits (Block B24)
Basic Industrial Math (Block X21)
Basic Industrial Math (Block X21)

What Students Learn:

In this block, the trainee will see how simple circuits are modified (enhanced, improved upon) to produce complex circuits and systems for industrial applications. This is an important subject. The trainee will now begin to see how two or more basic and complex circuits are tied together to create an industrial electronics system. The emphasis will be away from what the individual schematic looks like, but to a "functional block diagram" concept. The trainee is shown large-scale schematics of which particular functional circuits will be identified and discussed. These functional circuits are treated as "blocks," then all tied together. The courses highlight the input and output conditions of an entire system and for each functional block.

Special Notes:

This updated course replaces Electronic Systems, Block B05. Each study unit contains a progress exam.

Components:

Electronic Devices and Amplification (086045)
Audio and RF Circuits (086046)
Oscillators, Feedback, and Waveforms (086047)
Electronic Power Supply Systems (086048)
Industrial Amplification Systems (086058)
Servo and Control Systems (086059)
Pulse and Logic Circuits (086060)
Programmable Controllers and Microprocessors (086061)

086045 Electronic Devices and Amplification

Objectives:

- Calculate the gain of an amplifier circuit.
- Calculate voltage, current, and impedance relationships in transformers.
- Convert power and voltage gain to decibels.
- Determine the resistance values needed in an impedance-matching pad.
- Identify the characteristics of amplifying devices in various configurations.

- Calculate the percentage of voltage regulation in a power supply.
- Explain the operation of filters and bleeder resistors in power supplies.
- Describe the purpose of a voltage divider network to the output of a power supply.
- Explain the operation of electronic power supplies.
- Describe the operation of several commonly used industrial power supplies.

086046

Audio and RF Circuits

Objectives:

- Describe how sound intensity is measured.
- Compare the advantages of AM and FM transmissions.
- Describe how narrow-band FM is used in industrial communications.
- Explain the advantages of coaxial cable over copper wire as a transmission medium.
- Describe how pushbutton dialing can be used in industrial systems.
- Explain the different methods used to assemble common-emitter amplifiers.

086047

Oscillators, Feedback, and Waveforms

Objectives:

- Identify the basic types of oscillator circuits.
- Discuss the various feedback circuits used in oscillators.
- Identify particular types of oscillator output waveforms.
- Recognize specific applications of oscillator and waveform generator circuits.
- Understand how a phase-locked loop works as a frequency synthesizer.
- Explain how a 555 integrated circuit timer / oscillator produces a square wave.

086048

Electronic Power Supply Systems

Objectives:

- Explain the basic function of rectifiers.
- Describe how half-wave and full-wave rectifier circuits operate.
- Determine the output voltage from various rectifier circuits.

086058

Industrial Amplification Systems

Objectives:

- Recognize the difference between a power and voltage amplifier.
- Work with V-MOS, BiFET, Darlington pair, push-pull, and complementary amplifiers.
- How to use amplifiers to obtain the desired phase angle relationship when wiring a two-phase induction motor.
- Analyze an OP-amp on the basis of the virtual ground or summing point.
- Understand how an amplifier introduces distortion and noise in an amplified signal.

086059

Servo and Control Systems

Objectives:

- Discuss the basic operation of servo systems.
- Relate the differences between open-loop and closed-loop systems.
- Identify commonly used symbols for servo system components and devices.
- Point out applications of servo systems in industry.
- Calculate the gain of a servo system.
- List the various types of servo systems and their basic purpose or function.

086060

Pulse and Logic Circuits

Objectives:

- State the various characteristics of pulse-generating circuits.
- Cite typical industrial applications of pulse generators.
- Indicate the advantages of various logic families.
- Discuss how digital control signals are processed.
- Develop a logic diagram using typical logic gate symbols.

086061

Programmable Controllers and Microprocessors

Objectives:

- Describe the typical industrial applications of programmable controllers.
- State the function of the various blocks of a microprocessor system.
- Indicate typical input/output (I/O) equipment and devices.
- Identify the commonly used programming languages.
- Develop a simple program.

086064

Industrial Electronic Troubleshooting

Objectives:

Preview

In a modern industrial plant, thousands (or even tens of thousands) of components work together to make a product. Many machines can now operate for long periods of time without requiring service. This is mainly due to excellent engineering and advances in metallurgy, the construction of electronic components, and the composition of lubricants. As long as proper maintenance work is performed, a machine may last for a very long time. However, it is inevitable that, at some point, one of those thousands of components will fail. A component failure will result in an equipment shutdown or a faulty product. At this time, workers with troubleshooting experience become invaluable.

A number of different skills are required to troubleshoot a machine or a piece of equipment effectively. In this study unit, students will learn about some of the more abstract troubleshooting procedures. These procedures will require the troubleshooter to collect information and focus on the failed component, not just connect a meter to make measurements.

Objectives

When a student completes this study unit, he and she will be able to:

- Explain why a safety inspection is the first inspection that should be made on a failed piece of equipment.
- Discuss how to make safety a part of all troubleshooting and repair procedures.
- Understand how to collect accurate data on trouble clues.
- Describe how to use system indicators to help you troubleshoot an electronic system problem.
- List the steps for proper basic troubleshooting, such as identifying failure trends, seeking obvious causes, and circuit board swapping.

- Describe how to perform advanced troubleshooting, such as using binary divide techniques and focusing on one of many failure possibilities.
- List the aptitude and attitude qualities needed to be a good industrial troubleshooter.

Contents

Introduction; Using Safe Work Practices; Basic Troubleshooting Procedures; Collecting Trouble Symptom Data; Advanced Troubleshooting Procedures.

086066

Troubleshooting Sensing Devices and Systems

Objectives:

Preview

Sensors are a very important part of any industrial control system. Sensors are provided to the input devices that send signals to these components responsible for monitoring and controlling an industrial system. Input devices indicate when an output device can be safely turned on and how long they should remain on.

In the past, the most popular input device was the limit switch. Although limit switches are still used, non-contact sensors, such as proximity sensors and photoelectric sensors, are becoming more common in industrial applications. Likewise, thermocouples were once popular for sensing temperature. However, modern systems may employ many different types of thermocouples, resistance temperature devices (RTDs), or even semiconductor temperature sensors. Some input devices rely on fiber optics and lasers to perform tasks. These devices and others may rely on their own small IC microchip planted within the sensor. Microchip equipped sensors can be placed on a simple four wire system along with hundreds of other sensors, allowing for a networked grouping of input and output devices.

Students will learn about different types of industrial input devices. In addition, trainees will study some troubleshooting procedures that will prove useful when one of these devices has failed.

Objectives

When a student complete this study unit, he and she will be able to:

- Identify the components of a typical limit switch and describe how to test these devices.
- Describe the operation of pressure switches.
- Identify, the components of, and troubleshooting procedures for, temperature sensing devices and level indicators.
- Describe, the operation of, and troubleshooting methods for, proximity, ultrasonic, photoelectric, fiber optic, and laser sensors.
- Define the proper troubleshooting methods for sensors that are connected to input modules.

Contents:

Troubleshooting Industrial Contact Sensors;
Troubleshooting Proximity and Ultrasonic Sensors;
Photoelectric Sensors; Industrial Sensor Input / Output
Troubleshooting.

086067

Troubleshooting Industrial Control Systems and Output Devices

Objectives:

Preview

The purpose of an industrial output device is to perform controlled work. These devices may be used to start a motor or to control the supply of pressurized air or hydraulic fluid to the actuators of a machine or a robot. In every automated industry, some type of output device controls the functions of a machine.

This study unit focuses on various forms of output devices, output modules, closed-loop systems, and human and machine interfaces. These devices and systems make up the majority of today's industrial systems. This study unit also covers troubleshooting procedures for these systems.

Objectives

When a student completes this study unit, he and she will be able to:

- Describe the operation of relays and solenoids, and procedures for troubleshooting them.
- Explain how to troubleshoot across-the-line starters and contractors, including solid state controlled contractors.
- Explain the importance of arc suppression diodes and resistor and capacitor networks in output-device circuits.
- Define the operation of, and repair methods for, simple numeric readouts.
- Explain how DC and AC output modules operate and how to troubleshoot them.
- Identify different types of closed-loop control systems and methods to troubleshoot and repair them.
- Explain how to troubleshoot and repair human and machine interface systems.

Contents

Troubleshooting Output Devices; Troubleshooting Output Modules; Troubleshooting Closed-Loop Systems;
Troubleshooting Human and Machine Interfaces.

086068

Troubleshooting Industrial Computer Systems and Software

Objectives:

Preview

On today's factory floor, there are a wide variety of control systems. In the past, control systems were dedicated controllers, such as a motor's speed controller or a programmable logic controller (PLC). However, the type of dedicated controller is changing. The personal computer (PC) now controls or monitors many industrial processes. The personal computers that workers encounter may be standard models or specifically designed for industrial environments.

In addition to PCs, other equipment is used to identify each part of a manufactured product and the machines that created these parts. Bar code readers or scanners, and radio frequency tag systems perform these identification tasks. Vision systems listed above also identify component parts in an industrial environment. These systems employ a camera to closely analyze a component's features. All the systems require software to run the control or monitoring operations.

Objectives

When a student completes this study unit, he and she will be able to:

- Discuss the principle parts and memory types of a computer motherboard.
- Identify power supply components and ratings.
- Locate the main power supply fuse and identify the type of power supply by its connectors.
- Identify the various types of computer drive systems and their cables.
- List the repair and troubleshooting procedures for computer hardware and software problems.
- Describe the operation of, and troubleshooting procedures for, optical and radio frequency identification systems.
- Explain the purpose of vision system hardware and software, and the troubleshooting procedures for them.

Contents

Industrial Computer Components; Industrial PC Components; Repairing Industrial Computers; Computer-based Identification Systems; Industrial Computer Software.

086069

Industrial Computer Networks

Objectives:

Preview

In industry today, the use of networks is rapidly growing. Only a few years ago, industrial networking was just in an experimental stage. Today, however, most systems are equipped with standard Ethernet connections and preconfigured network operating systems. Many forms of equipment, such as motor drives and PLCs, are able to share a network controlled by one or more large personal computers.

This study unit provides students with an introduction to industrial networks. Trainees will become familiar with the terminology and learn about the components used in these systems. Trainees will realize that industrial networking is an exciting and fast growing field.

Objectives

When a student complete this study unit, he and she will be able to:

- Describe the methods of communication within networks.
- Explain the configurations of various types of industrial network systems.
- Identify and describe different types of network cables.
- Discuss various network protocols.
- Describe troubleshooting methods for networks.

Contents

Fundamentals of Industrial Communication Systems;
Network Configurations; Network Systems; Network
Operating Systems, Model, and Protocols;
Troubleshooting Network Systems.

B1001

Industrial Computer Fundamentals

Objectives:

- Give an overview of industrial computer uses including a history of computing in industry, analog computer development, digital logic in computer development, advent of bit-slice "microprocessors," monolithic microprocessors and LSI, and the microprocessor as the heart of the industrial computer.
- Describe industrial computers: What goes on inside an industrial computer, what goes on outside an industrial computer, microcomputer on a single chip, readout displays for industrial computers, industrial computers without displays, how micro- and mini-computers suit industrial applications, and where mainframe computers fit into industrial operations.
- Give examples of computers at work in industry including computer-aided design, computer-guided machinery, computer-directed research and analysis, controlling industrial and chemical processes, failure analysis and maintenance, programmable controllers for materials handling, nondestructive testing, measurements, inventory and supply logistics, and project control, reporting, and modeling.
- List the software required for industrial computers and tell what is needed (for systems in the above examples), who supplies it, and requirements for writing software; explain the function of programmers, systems analysts and technicians; describe methods for developing and debugging software.
- Explain the future of computers in industry.

B1002

Digital and Analog Systems

Objectives:

- Give a detailed overview of analog computer development: Describe what analog computing is - underlying principles, examples of present-day analog computers, mechanical vs. electrical analogs and how analog computers fit into industry.
- Give a detailed overview of digital computer development: Describe what digital computing is - underlying principles, why digital computing has largely replaced early analog computers.
- Describe the principles of control as used in industry including sensing control variables, switching control, proportional control and its variants, three-mode control, loop concepts of controlling processes, and open and closed loops.
- Tell how analog control systems operate including measurement techniques, processing analog signals and applying analog control.
- Tell how digital control systems operate including the nature of digital signals, converting analog measurements to digital signals, processing digital signals, applying digital control and converting digital back to analog.

B1003

Software and Programming

Objectives:

- Discuss software for industrial systems: Define software, what systems need software, and give industrial software examples.
- Describe the types of industrial software: What is available, where does it originate, how to prepare your own software, ladder diagrams, BASIC-language programs, Boolean algebra for logic systems, and assembly language programs.
- Identify the symbology for controller programs including: The symbols used to portray ladder logic, BASIC-(beginners all purpose symbolic instruction code), how to apply Boolean algebra principles, and how to use assembly language.
- Write simple programs, using ladder logic, in BASIC, using Boolean algebra in assembly language.

B1021

Progress Examination

B1004

Computer-Aided Control Systems

Objectives:

- Describe computer-aided design and computer-aided manufacturing: including what they are, who uses CAD and CAM and for what, and required hardware and software.
- Give a brief history of CAD and CAM.
- Explore the benefits of CAD and CAM: How they increase productivity, decrease costs, improve product quality, reduce project turnaround time and benefit personnel.
- Explain how to select and install CAD and CAM systems in industry: Identify applications for CAD and for CAM in circuit board design, integrated circuit design, hardwired circuit design, generating Numerical Control data, plant design and other possibilities.
- List sources of CAD and CAM information.

B1005

Interfacing Principles

Objectives:

- Explain the concept of interfacing and tell why interfacing hardware is needed: Describe serial interfacing, parallel interfacing and input-output categories.
- Understand analog to digital interfacing; explain when you need A to D, D to A methods, and applying A to D principles; describe sample and hold methods; explain why you need signal conditioning.
- Identify applications (closing the loop); making measurements, controlling machines, and controlling processes.
- Explain multiplexing and time sharing; tell why and when to multiplex, how to multiplex digital data and how to multiplex analog data.
- Explain communications standards: Review synchronous and asynchronous data; serial RS232C, RS442, RS423; parallel S100, 6800, IEEE488, IEEE583; review ASCII; long distance communications techniques; process control loop standards; sources for communications standards.

B1022

Progress Examination

B1020

Progress Examination Booklet

086E18

Digital Electronics

Duration: 60 hours (includes 6 tests)

Course Prerequisites: Electronic Systems (Block B25)

What Students Learn:

Lesson 1 – Number and Logic Systems:

- Perform various number and logic conversions including: decimal to binary and binary to decimal, binary to octal and octal to binary, binary to hexadecimal and hexadecimal to binary, and from decimal to BCD and BCD to decimal.

Lesson 2 – Boolean Algebra with OR Gate

Applications: • Reduce Boolean expressions; Write the truth table for an exclusive- OR gate; Designing and analyzing digital circuits; Use various theorems related to Boolean Algebra.

Lesson 3 – Adders and Collection Gates: • Define and draw the block diagram and truth tables for both half and full adders; Program a GAL device; Identify and calculate fan-out and noise margin; Applications for open-collector gates.

Lesson 4 – Flip-Flops and Shift Registers: • Operation of various flip-flop types including SR, master-slave, JK,

and D; How latches are used in control applications; IC flip-flops; Shift registers for serial communication devices; ASCII code and RS- 232 communication standards.

Lesson 5 – Counting and Timing Circuits and D/A and A/D Conversion:

- Binary counters; Frequency dividing using synchronous and asynchronous counters; Clock-pulses generators; Multivibrator circuits incorporating the 555 timer IC; A/D and D/A converter construction.

Lesson 6 – Digital Electronic Applications: •
Decoders, multiplexers, and demultiplexers; LED
connection;

Properly connecting tri-state output devices to
circuits; driving high- current transistor interfaces;
Circuit isolation; Memory; Microcomputers and
microcontrollers.

Special Notes:

- This course consists of a textbook and a
supplemental study guide.
- This course replaces Blocks B07, B08, and B09.

Block B11

Introduction to Microprocessors

Duration:

28 hours (includes 1 test)

Course Prerequisites:

Basic Industrial Math (Block X21)

Analog Circuit Measurement (Block A23)

What Students Learn:

This block provides an introduction to the fundamentals and
uses of computers in business and industry. The trainee learns
the basics of microprocessors, what they are comprised of, and
how they are used in industry. Logic arithmetic, logic gates,
and memory devices are described. This block describes the
architecture or makeup of a microprocessor, how instruction
or data enter a microprocessor, how such information is
handled inside the microprocessor, and how it exists.

Components:

Introduction to Computers (B1101)

Introduction to Microprocessor Applications (B1102)

Microprocessor Basics, Part 1: Underlying Principles and
Concepts (B1103)

Microprocessor Basics, Part 2: Overview of What's in a
Microprocessor (B1104)

Progress Examination (B1121)

Progress Examination Booklet (B1120)

B1101

Introduction to Computers

Objectives:

- Give an overview of how computers are used in
industry and business.
- List the main types of computers.

- Name the important activities performed by people who
work with computers.
- Explain how computers are selected and what must be
considered before they are selected and installed.

B1102

Introduction to Microprocessor Applications

Objectives:

- Explain what microprocessors are and the kinds of work
they do.
- Tell what makes it possible for them to accomplish so
much.
- List some of the recent applications microprocessors are
found in.

B1103

Microprocessor Basics, Part 1: Underlying Principles and Concepts

Objectives:

- Explain the importance of binary arithmetic in
microprocessor work.
- Sketch the common logic circuits.
- Identify the output conditions for the different possible
input conditions for logic gates.

B1104

Microprocessor Basics, Part 2: Overview of What's in a Microprocessor

Objectives:

- Draw a block diagram of a basic microprocessor unit
(MPU).
- Tell what bytes and bits are and how they enter and exit
an MPU.
- Explain how the MPU identifies, sorts, and holds bytes.
- List some of the activities of the ALU work center.

B1121

Progress Examination

B1120

Progress Examination Booklet

Block B07

Pulse Circuits

Duration:

42 hours (includes 2 tests)

Course Prerequisites:

Basic Industrial Math (Block X21)

Analog Circuit Measurement (Block A23)

Troubleshooting Electronic Equipment and Systems (Block B06)

What Students Learn:

In this series of lessons, the trainee will become familiar with pulse techniques and their characteristics. The trainee will learn how RC time-constant effects are used in pulse generation. Solid-state and electron-tube pulse generators and the various types of waveforms are covered. The various types of waveshaping circuits are discussed along with the concepts of how timing, triggering, and synchronization are achieved. Practical industrial applications of pulse circuits and the techniques of troubleshooting are covered.

Components:

Pulse Techniques (B0701)

Pulse Generators (B0702)

Waveshaping Circuits (B0703)

Progress Examination (B0721)

Timing (B0704)

Pulse Circuit Applications (B0705)

Troubleshooting Pulse Circuits (B0706)

Progress Examination (B0722)

Progress Examination Booklet (B0720)

B0701

Pulse Techniques

Objectives:

- Describe the term pulse and how it differs from nonpulse waveforms.
- Name and explain six terms that specify pulse dimensions.
- List four ways that pulses are generated or developed.
- Describe the frequency content or makeup of square waves, rectangular waves, sawtooth, and triangular waves, spikes, and half sine waves.

B0702

Pulse Generators

Objectives:

- Review the main methods of generating pulses.
- Review the concept of time constant and its relationship to pulse circuits.

- Explain the response of differentiator and integrator circuits to sine waves and pulses.
- Discuss pulse generation by sine wave clipping.
- Describe how pulses are developed by the relaxation oscillator, multivibrators, and switching circuits.
- Describe the operation of the Schmitt trigger.

B0703

Waveshaping Circuits

Objectives:

- Explain the operation of circuits for forming square and rectangular waves, sawtooth waves and triangular waves.
- Tell how pulses are stretched, narrowed, widened, and otherwise shaped or reshaped.
- Discuss the response of pulses to capacitors, transformers, and inductors.
- Illustrate how a clamper is used to restore shape to a pulse or a pulse series.

B0721

Progress Examination

B0704

Timing

Objectives:

- Discuss free-running and nonsynchronized pulses.
- Describe the 555 timer and name its applications.
- Show examples of using crystals for frequency stabilization.

B0705

Pulse Circuit Applications

Objectives:

- Review the uses of pulses in switching circuits.
- Tell how pulses are used in computers.
- Explain the concept of how pulses fits into data communication.
- Discuss digital audio and television techniques.
- Describe five uses of pulses in industry.

B0706

Troubleshooting Pulse Circuits

Objectives:

- Sketch typical oscilloscope waveforms for good pulses.

- Identify possible causes of trouble while examining photos or sketches of distorted pulses.
- Show how to use a logic probe in troubleshooting digital pulse circles.
- Demonstrate the use of a pulse generator in circuit troubleshooting.
- Describe the steps to troubleshoot resistance welding and other industrial equipment using pulses.

B0722

Progress Examination

B0720

Progress Examination Booklet

086E21

PLC Technology

Duration:

60 hours (includes 6 tests)

Course Prerequisites:

Basic Industrial Math (Block X21)

Analog Circuit Measurement (Block A23)

What Students Learn:

This course offers a complete and in-depth introduction to PLC hardware, programming, and the systems in which they are most often found. Trainees learn how a PLC handles multiple inputs and outputs, operates in a wide environmental range, and resists electrical noise, vibration, and impact. Programming and troubleshooting instruction focuses on practical installations and applications.

Introduction to PLCs – Lesson 1 (086830)

- Identify the basic components of a PLC and how they function within the system; Select hardware used with PLCs and connect them via input and output circuits; Explain PLC addressing and memory functions; Work with numbering systems used in programs; Interpret BCD, Gray, and ASCII codes; Perform basic arithmetic operations using binary numbers.

Basics of Programming and Ladder Logic – Lesson 2 (086831)

- Analyze binary gates functions using truth table and Boolean expressions; Use relay logic to convert real applications to ladder diagrams; Memory maps and using information from I/O devices; Write and enter basic ladder logic programs; Use switches, transducers, and sensors in PLC applications; Convert relay ladder logic diagrams into PLC ladder logic diagrams.

Programming Timers and Counters – Lesson 3

(086832)

- How PLC timers can function similar to mechanically actuated timers; Program timer functions in ladder diagrams and control outputs based on timer settings; Apply PLC counter instructions; Write programs using combinations of timers and counters.

Control and Data Manipulation Instructions – Lesson 4 (086833)

- Programming using jump, control, and subroutine instructions; Describe how control instructions can implement safety and maintenance procedures in the event of machine or process faults; Troubleshoot PLC programs; Use data manipulation instructions; Plan and program for closed loop control systems.

Math, Sequencer, and Shift-Register Instructions – Lesson 5 (086834)

- Apply math instructions in PLC ladder diagrams and to control processes; Write programs that use PLC sequencing instructions; Work with bit-shift and word-shift registers; Work with event-driven and time-driven processes.

PLC Installation and Process Control Systems – Lesson 6 (086835)

- Specify and plan for PLC environmental requirements; Practice specific PLC troubleshooting methods; Apply the correct control process for specific manufacturing processes; Interpret data-acquisition system specifications; Understand how computers communicate with each other in a manufacturing environment; Discuss general robotic and numerical control principles.

Special Note:

- This course consists of a textbook and supplemental study guide.
- This new course replaces *Industrial Microprocessors*, course 086E05.

Block B14

Industrial Electronic Circuit Applications

Duration:

35 hours (includes 2 tests)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

Analog Circuit Measurement (Block A23)

Logic Circuits (Block B08)

Basic Industrial Computer Systems (Block B10)

What Students Learn:

The purpose of this block is to relate electronic circuits and systems to typical industrial applications. Lessons cover such topics as numerical control (NC) systems, motor control and servo computer-aided control systems, transducers, supervisory and direct digital control systems, electronic instrumentation systems, programmable controller and robotic systems.

Components:

Interfacing Process Variables (B1401)
Motor Control and Servo Systems (B1402)
Numerical Control Systems (B1403)
Progress Examination (B1421)
Programmable Controllers (B1404)
Industrial Robots (B1405)
Progress Examination (B1422)
Progress Examination Booklet (B1420)

B1401

Interfacing Process Variables

Objectives:

- Show an understanding of process measurement and control; describe process variables, closed loop control, how to classify sensors, error source circuits.
- Compare computer control with traditional control; describe traditional closed loop control, SPC computer control, and DDC computer control; identify the advantages of computer control and its hardware/software.
- Describe temperature, pressure, flow, humidity, weight, and level; explain how each is measured and controlled; list the types of sensors used for each and identify the applications.
- Describe typical position sensors and their applications.
- Define analysis and speed; explain how to measure and control them; describe the sensors used and their applications.

B1402

Motor Control and Servo Systems

Objectives:

- Review of AC and DC motors: converting electric power to rotational power, DC motor concepts, electronic commutation, AC motor concepts; explain the concepts of work, load, torque, and slippage.
- Discuss how industrial motors are controlled: describe motor, control diagrams, and the principles of controlling motors; explain how speed and torque are sensed and indicate motor performance; explain how to process motor performance feedback and apply corrective signals to AC and DC motors.

- Discuss the principles of electronic servomechanisms including older analog systems, modern digital servo systems, positional sensing in rotational devices, reference signals, developing correction signals, applying correction signals, speed correction, phase correction, and programming industrial servo systems.
- Describe motor control systems: types still using gaseous-tube controllers, solid-state controllers, and servo systems; how to read motor-servo diagrams.

B1403

Numerical Control Systems

Objectives:

- Explain what is meant by numerical control including point-to-point control and contour control; compare absolute and incremental systems.
- Describe what makes up an NC system, what the controller does, some typical drives, and the servo components.
- Discuss the operation of an NC machine: data and control inputs, outputting control signals, closed vs. open loop, and ancillary features; identify the media for control programs: paper tape, magnetic tape and computers.
- Identify applications for NC: milling, drilling, reaming, counter boring and lapping, spot facing, and boring.

B1421

Progress Examination

B1404

Programmable Controllers

Objectives:

- State the basic purpose of a programmable controller and its relationship to computers and to robots.
- Show an understanding of a simple PC system: the block diagram, programmer (operator I/O), memory (PROM & ROM), and sequencer.
- Describe programming formats including Boolean algebra, and ladder logic.
- Explain flow charting and program coding.
- Describe interfacing: include analog input, analog output, and parallel I/O.
- Give a detailed description of a typical controller including operator I/O, memory, and sequencer.

B1405

Industrial Robots

Objectives:

- Give an overview of industrial robotics.
- Show an understanding of the make-up of an industrial robot including the controller, manipulator, and gripper.
- Explain how to classify industrial robots: low technology-LTR's, medium technology MTR's, and high technology-HTR's.
- Give a detailed explanation of a typical LTR, MTR, and HTR including the controller, manipulator, and gripper.
- Identify present applications for industrial robots when press loading, die casting, welding, and others.
- List sources of additional information.

B1422

Progress Examination

B1420

Progress Examination Booklet

Block B16

Advanced Troubleshooting Techniques

Duration:

42 hours (includes 2 tests)

Course Prerequisites:

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

Analog Circuit Measurement (Block A23)

Introduction to Microprocessors (Block B11)

Basic Industrial Electronic System Applications (Block B15)

What Students Learn:

This block provides the trainee with techniques for troubleshooting the typical electronic systems found in industry. A functional block approach to system troubleshooting opens the course. Next is a lesson on analyzing the system. The trainee learns to select the proper instrument for a particular fault. Attention is given to safe troubleshooting practices. Finally, two lessons highlight specific faults in troubleshooting typical industrial electronic systems.

Components:

Approach to Troubleshooting (B1601)

Analysis of Systems (B1602)

Test Equipment Applications (B1603)

Progress Examination (B1621)

Safe Troubleshooting Practices (B1604)

Troubleshooting Industrial Systems, Part 1 (B1605)

Troubleshooting Industrial Systems, Part 2 (B1606)

Progress Examination (B1622)

Progress Examination Booklet (B1620)

B1601

Approach to Troubleshooting

Objectives:

- Explain the importance of the block diagram approach to troubleshooting.
- Classify equipment functions by section.
- Locate which stage in a section is the trouble source.
- Narrow the trouble to a circuit.
- Pinpoint the faulty component.
- Troubleshoot to board level.
- Plan to reduce downtime.
- Explain good safety habits.

B1602

Analysis of Systems

Objectives:

- Discuss the importance of understanding the operation before troubleshooting.
- Tell the use of a logical approach to troubleshooting.
- Determine the exact trouble before tracking down its cause.
- Show how to use manufacturers' service manuals.
- How to use troubleshooting flowcharts.
- Measuring supply and power-source voltages.
- Checking input and output voltages.

B1603

Test Equipment Applications

Objectives:

- List test instruments considered essential for troubleshooting.
- Name some special instruments for industrial troubleshooting.
- Demonstrate how to use digital multimeters, VOMs, and oscilloscopes.
- Explain the use of frequency meters and counters.
- Show how to use a logic probe and a logic analyzer.
- Name four types of precision instruments used in industry, and explain their use.

B1621

Progress Examination

B1604

Safe Troubleshooting Practices

Objectives:

- Explain your obligation to work safety.
- Tell how to form safe working habits around electricity.
- List precautions to observe when using tools.
- Discuss why faulty equipment is sometimes a safety hazard.
- Show how faulty grounds present special hazards.
- Describe special safety considerations in medical and hospital equipment.
- Describe first aid for electric shock using CPR.

B1605

Troubleshooting Industrial Systems, Part 1

Objectives:

- Discuss checkout of power sources and supply voltages.
- State case histories of typical problems and how they were solved.
- Explain approaches to troubleshooting signal-level circuitry.
- Explain approaches to troubleshooting power-level circuitry.
- Tell how to handle "tough dogs" and intermittents.

B1606

Troubleshooting Industrial Systems, Part 2

Objectives:

- Discuss an approach to troubleshooting numerical control systems.
- Explain the major approach to troubleshooting programmable controllers.
- Describe ways to isolate problems in a chemical process control system.
- List important considerations in troubleshooting in hazardous locations.
- Review troubleshooting problems in the petro-chemical field.
- Discuss electronic equipment problems in the paper manufacturing industry.

B1622

Progress Examination

B1620

Progress Examination Booklet

086084

Distributed Control Systems, Part 1

Duration: 10 hours (includes 1 test)

What Students Learn:

- Basic types of control loops and their elements
- Define basic process control characteristics and terms
- Identify the five control modes found in industrial systems
- How control system components interface
- Basic components found in DCS architecture

086085

Distributed Control Systems, Part 2

Duration: 10 hours (includes 1 test)

What Students Learn:

- The characteristics and development of the HART protocol
- OSI layers used in HART messaging
- Distinguish between point-to-point and multidrop HART devices
- Functions of a device management system
- Seven layers of the OSI standard

086086

Distributed Control Systems, Part 3

Duration: 10 hours (includes 1 test)

What Students Learn:

- How Foundation Fieldbus works
- Functions and applications served with Foundation Fieldbus
- Determine existing fail-safe conditions
- Commands for opening a download
- Addressing thermal inertia

286M01

Pneumatic Instrumentation for the Technician

Duration:

35 hours (includes 7 tests)

Course Prerequisites:

Basic Industrial Math (Block X21)

What Students Learn:

Lesson 1 - Pneumatic Instrumentation for Industry:

- Instrument Systems; How Fluid Power Works; Pneumatic Instruments; Link Mechanisms: Components and Adjustments; Calibration Standards, Procedures and Programs.

Lesson 2 - Pressure and Liquid Level Measuring Instruments:

- Principles of Pressure; Sensing Pressure; Bourdon Elements; Compensation and Calibration; Liquid-Level Instruments; Differential Pressure Instruments: Manometers, Bellows and Diaphragm Instruments, Displaces.

Lesson 3 - Flow-Measuring Instruments:

- Principles of Operation; Orifice Flow; Meter Types and Mechanisms; The Square-Root Problem; Integrators.

Lesson 4 - System Components, Part 1:

- Self-Balancing Instruments; Error Detectors; Pilot Valves; Relay Functions and Variations; Moment-Balance Pressure, Temperature and Differential-Pressure Transmitters; Moment Balance Positioners.

Lesson 5 - System Components, Part 2:

- True Force-Balance Instruments, Transmitters and Positioners; Motion-Balance Principle and Applications; Angle Motion-Balance Positioners; Linear Motion-Balance Instruments.

Lesson 6 - Pneumatic System Control, Part 1:

- Control Valve Maintenance; Control Theory and Fundamental Controllers; Gain, Feedback and Response.

Lesson 7 - Pneumatic System Control, Part 2:

- Controller Functions, Types and Components; Range and Gain Mechanisms; Foxboro, Honeywell, Taylor, and Fisher and Porter Controllers; Universal Controllers; Process Control.

Special Notes:

This course consists of a textbook and supplemental study guide.

286M04

Control Technology for Technicians

Duration:

45 hours (includes 9 tests)

Course Prerequisites:

Basic Industrial Math (Block X21)

Practical Measurements (Block X22)

Introduction to Algebra, Geometry, and Trigonometry (Block X02)

What Students Learn:

This course introduces the fundamentals of control system components and operation. Students will learn how a control system works and how its operating characteristics can be interpreted from schematics and ladder logic diagrams. The course will explain how mechanical, hydraulic, pneumatic, electrical, and electronic components used in control systems measure parameters. These measurements are then converted into useful data or the appropriate control system response. The course discusses the use of feedback loops and their applications in real-world control systems. The student will understand how electronic systems are combined to deliver their acceptable data "signals" to computers. In conclusion, the student will learn how PLCs are used throughout industry to control complex systems.

Part 1 (286076) . Lesson 1 - Introduction to Control Systems

- Represent a control system with a block diagram.
- Recognize various control system types including open loop, closed loop, analog, and digital.
- Describe how servomechanisms work.

Lesson 2 - Op Amps and Signal Conditioning

- Explain how microprocessors are integrated into, and interface with, control systems.
- Evaluate and design op-amp and related signal conditioning circuits to be used in control systems.

Lesson 3 - Control System Switching Devices

- Describe the operating principles of, and applications for, relays, transistors, rectifiers, triacs and other switching devices.

Lesson 4 - Mechanical Control Systems

- Explain how mechanical components are designed into, and operate within, control systems.

Lesson 5 - Control System Sensors

- Evaluate the function of sensors in a given control system.
- Understand how sensors work to provide data in control systems.

Part 2 (286077). Lesson 6 - DC and Stepper Motors in Control Systems

- Explain how DC motors operate.
- Select a motor based on mechanical and performance requirements.
- Describe how DC motor control systems work.
- Understand how stepper motors and their driver circuits work.

Lesson 7 - AC Motors in Control Systems

- Explain how AC motors operate.
- Select a motor based on mechanical and performance requirements.
- Describe how AC motor control systems work.

Lesson 8 - Control System Actuators and Feedback Principles

- Recognize the applications for, and operating characteristics of, electric, hydraulic, and pneumatic linear actuators.
- Describe the operating principles of control valves and other components in hydraulic and pneumatic systems.
- Differentiate between proportional, integral, differential, and fuzzy logic control systems.

Lesson 9 - Relay Logic and PLCs

- Explain how to tune a process control system.
- Understand how analog and digital control circuits work.
- Explain the operation of relays, counters, and sequencers.
- Understand how PLCs work.
- Interpret ladder logic diagrams.

Special Notes:

This course consists of a textbook and two supplemental study guides. We recommend the course be purchased in its entirety. However, if needed due to targeted training, study guides (Parts 1 & 2) can be purchased separately, with or without the textbook. Note that the textbook is required for the Part 1 study guide. Call Customer Service for pricing and ordering information.

086E17

Electronic Process Control

Duration:

30 hours (includes 6 tests)

Course Prerequisites:

Control Technology for Technicians (286M04)

What Students Learn:

Lesson 1 – Electronic Control Basics:

- PID controller modes including proportional, integral, and derivative actions; Fuzzy Logic; Function of optoelectronic devices, integrators, differentiators, and Schmitt triggers; Classification of systems as open and closed loops.

Lesson 2 – Controlling Motors:

- DC, AC, and servo motor control; PWM drives.

Lesson 3 - Process Control and Instrumentation, Part 1:

- Process-temperature measuring devices; Flow-measuring devices and their application; Methods for measuring level (volume); pH sensing electrodes; Element-measuring instruments.

Lesson 4 – Process Control and Instrumentation, Part 2:

- Batch and continuous processes; Identifying functions of measurement and feedback instruments; Final control elements; Controller output signal range; Symbols in process control diagrams.

Lesson 5 – Sensors and Programmable Controls:

- Proximity switches; Photoelectric sensors; Simple ladder logic diagrams; PLC components.

Lesson 6 – Motion Control:

- Motion feedback devices; Motion-control parameters; Servomechanisms; Applications for optical detection sensors.

Special Notes:

This course consists of a textbook and a supplemental study guide.