Scientific Management Techniques, Inc.

Basic & Advanced
Mechatronics Training Programs

TRAINING OBJECTIVES

Training the Skills Required to Operate, Maintain, and Troubleshoot a Modern Manufacturing Facility

The program curriculum is 100% demand driven. We train to the specific skills our clients have conveyed to us as critical for productive long-term employment.

This manufacturing skills training curriculum has been built by and for manufacturing operations professionals over the last forty years.

Consider this program an ongoing "needs analysis" of the skills required to optimize industrial performance. Existing curriculum units are updated and new units are introduced based on Real-Time needs identified by our global industrial client base.

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Basic Mechatronics Training Program

Shop Mathematics – Volume 1, Unit 1
Base 10 – Decimals, Decimal Equivalents, and Percentages

1. Read decimals to six places.
2. Change any decimal into its fractional equivalent.
3. Change any fraction into its decimal equivalent.
4. Use the decimal point correctly in the addition and subtraction of decimal numbers.
5. Use the decimal point correctly in the multiplication of decimal numbers.
6. Use the decimal point correctly in the division of decimal numbers.
7. Translate percentiles to numbers.
8. Find percentage of any number, given base and rate.
9. Find the percent any number is of another, given base and percentage.
10. Find any number when a percent of that number is known, given its rate and percentage.

Shop Mathematics – Volume 1, Unit 2
Fractions and Mixed Numbers

1. Recognize proper and improper fractions.
2. Translate improper fractions into mixed numbers.
3. Translate mixed numbers into improper fractions.
4. Add and subtract fractions with like denominators.
5. Find fractional Equivalents
6. Add and subtract fractions with unlike denominators.
7. Add and subtract mixed numbers.
8. Multiply fractions.
9. Divide fractions.

Shop Mathematics – Volume 1, Unit 3
Algebraic Expressions, Simple Equations, Ratio and Proportion

1. Use parentheses and coefficients in algebraic expressions.
2. Write and solve simple algebraic equations of addition and subtraction.
3. Write and solve simple algebraic equations of multiplication and division.
4. Apply the two basic rules for solving equations of simple algebraic expressions.
5. Translate mathematical problems into algebraic expressions.
6. Solve common formulas for an unknown quantity.
7. Write ratios and simple proportions as equivalent fractions.
8. Solve equations of proportion involving an unknown quantity.
9. Solve common problems involving an unknown quantity.

Shop Mathematics – Volume 1, Unit 4
Graphs, Charts, and Data Handling

1. Interpret scale representation of data.
2. Construct chart representations of data.
3. Find range and average of numerical data.
4. Construct line graph representations of data.
5. Construct bar graph representations of data.

Shop Mathematics – Volume 1, Unit 5
Weights, Measures, and Metric Conversions

1. Change measures to units of smaller denomination.
2. Change measures to units of larger denomination.
3. Add measures.
4. Subtract measures.
5. Multiply measures.
6. Divide measures.
7. Read metric numbers.
8. Convert U.S. linear measures to Metric linear measures, and convert Metric linear measures to U.S. linear measures.
9. Convert U.S. liquid measures to Metric liquid measures, and convert Metric liquid measures to U.S. liquid measures.
10. Convert U.S. weights to Metric weights, and convert Metric weights to U.S. weights.

Shop Mathematics – Volume 1, Unit 6
Exponents, Square Roots, and Right Triangles

1. Eliminate exponents in mathematical expressions.
2. Solve simple equations using exponents.
3. Use positive and negative powers of ten.
4. Simply mathematical expressions using square roots.
5. Solve simple equations using square roots.
6. Find square roots not in the tables.
7. Identify right triangles by form and components.
8. Use the Pythagorean Theorem to find missing component on right triangles.
9. Solve common problems involving right triangles.
10. Solve common problems involving exponents and roots.

Shop Mathematics – Volume 1, Unit 7
Angles, Perimeter, and Area

1. Measure and draw angles using a protractor.
2. Measure angles of triangles and rectangles.
3. Find the perimeter of closed plane-figures having straight sides.
4. Find area of squares and rectangles.
5. Find area of triangles.
6. Find area of parallelograms and trapezoids.
7. Find perimeter (circumference) of circles.
8. Find area of circles and sectors (arcs).
9. Find area of rings.
10. Find circular area and surface area of cylinders.

Shop Mathematics – Volume 1, Unit 8
Measurement of Solid Figures – An Introduction to Trigonometry

1. Find the volume of rectangular solids.
2. Find the volume of rectangular wedges.
3. Find the volume of cylinders.
4. Find the volume of cones and pyramids.
5. Find the angle of a right triangle to seconds, given the other two.
6. State trigonometric ratios for Sines, Cosines, and Tangents.
7. Write trigonometric ratios for Sines, Cosines, and Tangents.
8. Use the trigonometric tables to find values of Sines, Cosines, and Tangents.

Shop Mathematics – Volume 1, Unit 9
Shop Trigonometry and use of the Trigonometric Tables

1. Review the trigonometric functions – sines, cosines, and tangents.
2. Review the use of the trigonometric tables.
3. Find the values for sines, cosines, and tangents through interpolation of the trigonometric tables.
4. Find the values for angles through interpolation of the trigonometric tables.
5. Solve right triangles using the sine function.
6. Solve right triangles using the cosine function.
7. Solve right triangles using the tangent function.
8. Solve isosceles triangles using trigonometric functions.

Elements of Blueprints – Volume 2, Unit 1
Elements of Blueprints and Machine Drawing I

1. Use orthographic projection techniques to describe three dimensional objects.
2. Use auxiliary views in conjunction with orthographic projections to describe three dimensional objects.
3. Use sectioning to describe internal features of three dimensional objects.
4. Interpret features of engineering drawing: linework and dimensioning.
5. Interpret title blocks of engineering drawings.
6. Interpret complete engineering drawings
7. Interpret assembly drawings.

Measurement – Volume 3, Unit 1
Measurement

1. Linear Measurement.
2. The Steel Rule.
3. The Combination Square.
4. The Combination Square with Center Head.
5. The Vernier Scale.
6. Reading the Vernier Scale.
7. The Combination Vernier Caliper.
8. The Vernier Micrometer.
9. Reading the Vernier Micrometer.
10. Care of Measuring Devices.

Basic Hand Tools – Volume 4, Unit 1
Hand Tools

1. Recognize the major types of hammers and be familiar with their functions.
2. Recognize the major types of chisels and be familiar with their functions.
3. Recognize the major types of pliers and be familiar with their functions.
4. Recognize the major types of wrenches and be familiar with their functions.
5. Recognize the major types of screwdrivers and be familiar with their functions.
6. Recognize the major types of punches and be familiar with their functions.
7. Be familiar with hacksaws and demonstrate their use.
8. Be familiar with files and demonstrate their use.
9. Be familiar with drills and demonstrate their use.

Basic Hand Tools – Volume 4, Unit 2
Mechanical Fasteners

1. Be familiar with thread terminology.
2. Recognize thread shape, form, and notation.
3. Be familiar with standard screws and shoulder bolts.
4. Be familiar with wrenches and screw size.
5. Be familiar with hole taps.
6. Recognize standard washers and nuts.
7. Be familiar with retaining rings.
8. Be familiar with small rivets.

Basic Mechanical Components I – Volume 5, Unit 1
Basic Machines

1. Find the mechanical advantage of a pulley and be familiar with its common applications.
2. Find the mechanical advantage of a wheel and axle and be familiar with its common application.
3. Find the mechanical advantage of a lever and be familiar with its common applications.
4. Find the mechanical advantage of an inclined plane and be familiar with its common applications.
5. Be familiar with the common applications of a wedge,
6. Find the mechanical advantage of a screw and be familiar with its common applications.

Basic Mechanical Components I – Volume 5, Unit 2
Shafts, Couplings, Pulleys, Belts, and Chain Drives

1. Be familiar with the functions of shafts, keys, and pins.
2. Be familiar with the major types of shaft couplings.
3. Be familiar with V-Belt and Pulley drive mechanisms.
4. Calculate speed and pulley size for V-Belt and Pulley drive mechanisms.
5. Be familiar with Gear Belt and Pulley drive mechanisms.
6. Calculate speed and pulley size for Gear Belt and Pulley drive mechanisms.
7. Be familiar with Chain and Sprocket drive mechanisms.
8. Calculate speed and pulley size for Chain and Sprocket drive mechanisms.

Basic Mechanical Components I – Volume 5, Unit 3
Gears and Gear Ratios

1. Be familiar with the basic terminology of gearing
2. Calculate pitch diameter and number of gear teeth using Diametrical Pitch.
3. Spur gears – Calculate their speed and number of teeth.
4. Be familiar with helical and herringbone gearing.
5. Be familiar with worm gears and calculate their speed.
6. Be familiar with bevel, miter, and spiral gearing.
7. Be familiar with gear trains and calculate their speed.

Basic Mechanical Components I – Volume 5, Unit 4
Couplings

1. Discuss the various categories of couplings.
2. Define the types of couplings in each category.
3. Explain the advantages and disadvantages of each coupling.
4. Relate coupling type to typical applications.

Basic Mechanical Components I – Volume 5, Unit 5
Basic Alignment

1. Define why alignment is important.
2. Determine when alignment is required.
3. Explain the benefits of accurate alignment.
4. Define the terms used in alignment procedures.
5. Stress the importance of safety procedures.
6. Understand the typical tools used in basic shaft alignment.
7. Assess the conditions prior to alignment.
8. Define measurements that are made prior to alignment.
9. Teach the basic method of shaft alignment.
10. Suggest recording procedures for the alignment process.
11. Understand the basics of thermal growth.

Bearings and Lubrication – Volume 6, Unit 1
Principles of Bearing Operation, Components, Journal Bearings, Ball and Roller Bearings

1. Be familiar with bearing technology.
2. Be familiar with the characteristics and functions of plain bearings.
3. Be familiar with the characteristics and functions of ball bearings.
4. Be familiar with the characteristics and functions of roller bearings.
5. Be familiar with the rotational forces on shafts and bearings.
6. Be familiar with the characteristics and functions of thrust bearings.
7. Be familiar with bearing lubrication.
8. Be familiar with bearing maintenance technique.

Bearings and Lubrication – Volume 6, Unit 2
Principles of Friction and Lubricants

1. Be familiar with the characteristics of friction.
2. Compare the static and kinetic friction of lubricated and nonlubricated sliding elements.
3. Be familiar with the functions of lubricants.
4. Be familiar with the major types of lubricants.
5. Be familiar with the lubrication of gear mechanisms.
6. Be familiar with the lubrication of plain and anti-friction bearings.
7. Recognize the major methods of lubrication.
8. Be familiar with techniques for storing and handling lubricants.

Basic Mechanical Components II – Volume 7, Unit 1
Levers, Cranks, Linkages, and Springs

1. Be familiar with levers as machine elements.
2. Calculate force and distance adjustments in simple lever applications.
3. Be familiar with the cranks as machine elements.
4. Be familiar with linkages and how they function.
5. Be familiar with the four bar linkage and its variations.
6. Be familiar with springs as machine elements.
7. Identify simple machine elements in compound machinery.

Basic Mechanical Components II – Volume 7, Unit 2
Cams and Timing

1. Be familiar with cams as machine elements.
2. Recognize the major types of cams.
3. Be familiar with the components of cam applications.
4. Layout a simple plate cam.
5. Measure the relationship between cam shape and stroke length in a given application.
6. Measure the relationship between cam shape and stroke timing in a given application.
7. Be familiar with cam maintenance techniques.
8. Identify machine elements in cam applications.

Basic Mechanical Components II – Volume 7, Unit 3
Use of Elementary Timing Model in Timing Adjustments

1. Be familiar with the elements of machine drawing.
2. Be familiar with the interaction of timing elements.
3. Be familiar with the installation and use of timing wheels.
4. Construct standard and bar timing charts.
5. Be familiar with basic timing adjustments.
6. Make basic timing adjustments using the Elementary Timing Model.
7. Chart basic timing adjustments for the Elementary Timing Model.

Machine Adjustment Fundamentals Using The Advanced Timing Model – Volume 8, Unit 1
Troubleshooting, Problem Identification, Principles of Problem Solving

1. Be familiar with the principles of problem solving.
2. Be familiar with problem description and downtime reports.
3. Be familiar with possible and probable cause.
4. Be familiar with corrective procedures and solution verification.
5. Be familiar with troubleshooting charts.
6. Make up a troubleshooting chart.
7. Practice using problem solving techniques.

Machine Adjustment Fundamentals Using The Advanced Timing Model – Volume 8, Unit 2
Set up Machine Standards Using the Advanced Timing Model

1. Be familiar with problem solving techniques as they apply to multiple systems.
2. Be familiar with the construction of the Advanced Timing Model.
3. Be familiar with the eight systems of the Advanced Timing Model.
4. Be familiar with the operating standards of the Advanced Timing Model.
5. Be familiar with the major types of machine adjustments.
6. Set the Advanced Timing Model to operating standards.
7. Chart the timing of the Advanced Timing Model.

Machine Adjustment Fundamentals Using The Advanced Timing Model – Volume 8, Unit 3
Problem Solving on Multiple Systems Using the Advanced Timing Model

1. Be familiar with troubleshooting charts for the Advanced Timing Model.
2. Describe and solve adjustment problems of the Advanced Timing Model.
3. Be familiar with the significance of settings and tolerances.
4. Determine the range of tolerances for different systems within the Advanced Timing Model.
5. Be familiar with Machine Standards Records.
6. Complete Machine Standards Records for the Advanced Timing Model.

Basic Pneumatics and Hydraulics – Volume 8A, Unit 2A
Air Compression, Properties of Air

1. Be familiar with the properties of air.
2. Be familiar with the operation of a simple reciprocating compressor.
3. Be familiar with the operation of a multi-stage reciprocating compressor.
4. Be familiar with the operation of a non-lubricating reciprocating compressor.
5. Be familiar with air pressure measuring instruments.

Basic Pneumatics and Hydraulics – Volume 8A, Unit 2B
Basic Pneumatics, Compressors, Air Pressure Gauges

1. Be familiar with the components and operation of a basic air system.
2. Be familiar with the safety rules for air systems.

Basic Pneumatics and Hydraulics – Volume 8A, Unit 3A
Hydraulic Flow and Control

1. Understand the nature of hydraulics as a work medium.
2. Understand the principles of pressure.
3. Calculate the area of a piston or ram.
4. Understand parallel and series flow paths.
5. Understand pressure through an orifice and pressure drops.
6. Understand principles of flow and velocity.
7. Understand the functions of the major components in a hydraulic system.
8. Understand the properties of hydraulic fluids.
9. Understand hydraulic diagrams and symbols.
10. Understand connecting lines and fittings.

Electrical Components – Volume 9, Unit 1
Principles of Electricity, AC/DC Circuits

1. Be familiar with the nature of electricity.
2. Be familiar with the elements of electrical flow.
3. Be familiar with basic electrical measurements.
4. Be familiar with electrical circuits and circuit diagrams.
5. Be familiar with the concept of power in electrical circuits.
6. Be familiar with basic safety rules for working with electrical circuits.
7. Be familiar with simple DC circuits and measure their electrical properties.
8. Be familiar with simple AC circuits and the properties of inductance and capacitance.

Electrical Components – Volume 9, Unit 2
Basic Circuit Components, Switches, and Relays

1. Be familiar with common types of electrical conductors.
2. Be familiar with common types of conductor insulation and mechanical protection.
3. Be familiar with basic National Electrical Code (NEC) definitions.
4. Recognize and make common splices and joints for electrical circuits.
5. Be familiar with fuses and circuit breakers.
6. Be familiar with common electrical switches.
7. Be familiar with solenoids and relays.
8. Be familiar with techniques for troubleshooting electrical circuits.

Electrical Components – Volume 9, Unit 3
Digital Multimeter and Basic Measurements

1. Use the multimeter for testing and measuring.
2. Understand the four main electrical measurements: Voltage, Current, Resistance, and Continuity.
3. Understand practical application of multimeter measurements as a troubleshooting device in industrial environments.
4. Select the DMM required for specific category ratings.
5. Be able to take accurate measurements of voltage, current, resistance, and continuity in a practical circuit of the kind typically used in industry.
6. Understand and follow correct safety procedures for taking measurements used in industry.
7. Be familiar with simple electrical circuits and understand how to simplify and calculate the main parameters.

Electrical Components – Volume 9, Unit 4
Input and Output Devices

1. Be familiar with I/O Devices within an electrical system.
2. Understand the operation of the most common Input devices: Switches, Sensors, Thermocouples, and Transducers.
3. Be familiar with the operation of electrical motors: AC and DC Motors
4. Understand the operation of the most common Output devices: Motors, Lights, Heaters, Pumps, and Solenoids.

Electrical Components – Volume 9, Unit 5
Electrical Schematics

1. Identify and understand functions of electrical components used in industry.
2. Learn to identify graphic symbols in electrical drawings.
3. Learn to interpret electrical drawings used in industry.
4. Learn how to follow control schemes from the point of understanding and troubleshooting the circuit.
5. Construct simple circuits by correctly following circuit schematics to help understand the principles of electrical flow.

Electrical Components – Volume 9, Unit 6
Generators and Transformers

1. Understanding voltage generation through a magnetic field.
2. Understanding sine wave generation.
3. Understanding the generator principle.
4. Understanding transformer principles.
5. Understanding transformer current and power relationships.
6. Solving transformer problems using turn ratio, ohms law, and power formulas.
7. Understanding advantages and uses of transformers.
8. Understanding line load and line loss, as well as voltage drop.

Electrical Components – Volume 9, Unit 7
DC Machines

1. Understand Electrical Machine definitions.
2. Understand the separately excited generator.
3. Understand the self excited generator.
4. Understand motor principles.
5. Understand motor/generator relationships.
6. Principles of counter torque and counter voltage.
7. Energy flow of DC machines.
8. Starting a DC motor.
9. Motor speed control.
10. Understand series motors.
11. Understand motor braking.

Electrical Components – Volume 9, Unit 8
Three- Phase AC and DC Motors

1. Understand common voltage point and grounding.
2. Introduction to three-phase voltage.
3. Understand Wye and Delta connections.
4. Understand and calculate phase voltage, and phase current.
5. Understand three-phase power.
6. Understand three-phase induction motors.
7. Understand and calculate motor synchronous speed.
8. Understand speed control using frequency inverters and variable frequency power supplies.
9. Understand wound rotor motors and squirrel case motors.
10. Understand the starting requirements for three-phase motors.
11. Understand braking of AC motors.
12. Understand single-phase motors. Brush type, induction, and synchronous types.

Pump Basics – Volume 10, Unit 1
Pumping Basics

1. Be familiar with the different types of pumps.
2. Be familiar with pressure and measurement.
3. Understand what liquid head is used for.
4. Be familiar with hydraulic terms.
5. Understand what causes cavitation and its effects.
6. Be familiar with how a circumferential piston rotary pump works.
7. Understand centrifugal force.
8. Be familiar with how a centrifugal pump works.
9. Understand static head of a pump system.
10. Be familiar with the different available pump seals.

Valve Operation and Types – Volume 11, Unit 1
Valve Operations and Types

1. Be familiar with the different types of valves.
2. Understand the uses for each valve.
3. Be familiar with valve parts.
4. Be familiar with hygienic designs.

Basic Process Control – Volume 11A, Unit 1
Introduction to Process Control

1. Understanding of basic Process Control concepts.
2. Understanding of components of a process.

Basic Process Control – Volume 11A, Unit 2
Basic Definitions

1. Understanding basic pressure definitions.
2. Understanding basic temperature definitions.
3. Understanding basic flow definitions.
4. Understanding basic level definitions.
5. Understanding analog definitions.
6. Understanding digital definitions.

Basic Process Control – Volume 11A, Unit 3
Pressure

1. Understanding principle of pressure.
2. Understanding pressure measurements.
3. Understanding Bourdon Tubes.
4. Understanding electronic sensors.
5. Understanding zero suppression and elevation.

Basic Process Control – Volume 11A, Unit 4
Temperature

1. Understanding types of temperature scales.
2. Understanding latent heat.
3. Understanding monitoring points and effects.
4. Understanding Thermowells.
5. Understanding Bimetallic devices.

Basic Process Control – Volume 11A, Unit 5
Level

1. Understanding level dynamics.
2. Understanding Ullage vs. Innage.
3. Understanding direct readings.
4. Understanding indirect readings.
5. Understanding measuring instrument types.
6. Understanding effects of temperature and viscosity.

Basic Process Control – Volume 11A, Unit 6
Flow

1. Understanding Reynolds numbers.
2. Understanding types of flow measurement.

Basic Process Control – Volume 11A, Unit 7
Analytical

1. Understanding types of analytical measurements.
2. Understanding quality control.
3. Understanding pH.
4. Understanding Oxidation Reduction Potential (ORP)
5. Understanding conductivity.
6. Understanding turbidity.
7. Understanding opacity.

Basic Process Control – Volume 11A, Unit 8
Transmitters

1. Understanding transmitter signals and scaling.
2. Understanding linear vs. nonlinear scaling.
3. Understanding transducers.

Basic Process Control – Volume 11A, Unit 9
Controllers

1. Understanding controller functions.
2. Understanding direct acting vs. reverse acting.
3. Understanding proportional band.
4. Understanding integral action.
5. Understanding derivative action.
6. Understanding bumpless transfer.
7. Understanding type of controllers.

Basic Process Control – Volume 11A, Unit 10
Process Control and Control Loops

1. Understanding the process variable.
2. Understanding control loop design.
3. Understanding a closed loop.
4. Understanding the loop components.
5. Understanding signal transmission.
6. Understanding live zero.

Basic Process Control – Volume 11A, Unit 11
Control Schemes

1. Understanding loop terminology.
2. Understanding cascading.
3. Understanding ration control.
4. Understanding relation control.
5. Understand feed forward control.
6. Understanding feedback control.
7. Understanding advanced control schemes.
8. Understanding signal conditioning.
9. Understanding noise.
10. Understanding Smart technology.

Advanced Mechatronics Training Program

Introduction to Industrial Maintenance – Volume 12, Unit 1
Failure Analysis

1. Be familiar with the principles and types of industrial maintenance.
2. Understand the methods of analysis for determining failures.
3. Be familiar with the techniques of failure diagnostics.

Gearbox Maintenance – Volume 13, Unit 1
Gear Maintenance

1. Understand the main characteristics of a gearbox by analyzing its fundamental components, concepts, and basic measurements.
2. Be familiar with the installation of parallel shaft gearing, including the installation of spur gears, helical gears, and tapered roller bearings.
3. Be familiar with the installation of 90° shaft gearing, including installation and adjustment of bevel gears and miter gears.
4. Be familiar with the installation of cross shaft gearing, including the installation and adjustment of worm/worm gear sets.

Bearing Maintenance – Volume 14, Unit 1
Bearing Maintenance

1. Understand the main characteristics of bearings by analyzing their different types, identification systems, construction, and terminology.
2. Be familiar with a Bearing Maintenance Pre-Check List.
3. Understand the most common failures in bearings and find the solutions.
4. Be familiar with the different mounting, dismounting, and installation procedures of bearings.

Advanced Pneumatic Components – Volume 15, Unit 1
Pneumatic Components

1. Understand the compressed air generation process, the air treatment, and distribution.
2. Recognize the different types of control valves.
3. Recognize the different types of actuators that can be found in industrial applications, understanding the solutions that pneumatics offer in automatic systems.

Advanced Pneumatic Components – Volume 15, Unit 2
Circuit Design

1. Understand the operation of the components included in a pneumatic control circuit.
2. Be familiar with the operation charts: Path-step chart and Path-time chart.
3. Recognize the pneumatic circuit design methods by analyzing different applications and practical cases.
4. Apply sequential control tasks and design pneumatic circuits.

Advanced Hydraulic Fundamentals – Volume 16, Unit 1
Hydraulic Components

1. Understand the basic components of a hydraulic system and their operation.
2. Recognize the different types of control valves.
3. Understand the principle of operation of hydraulic actuators.

Advanced Hydraulic Fundamentals – Volume 16, Unit 2
Circuit Design

1. Understand the operation of the components included in a hydraulic control circuit.
2. Be familiar with the operation charts.
3. Recognize the hydraulic circuit design methods by analyzing different applications and practical cases.
4. Apply sequential control tasks and design hydraulic circuits.

Advanced Electrical – Volume 17, Unit 1
Capacitors

1. Learn what a capacitor is and what its uses are.
2. Understand the properties of capacitors.
3. Understand capacitance time constant.
4. Understand capacitors in AC circuits.
5. Understand reactance factors.
6. Understand phase shift.
7. Understand impedance.

Advanced Electrical – Volume 17, Unit 2
Inductors

1. Learn what an inductor is and its uses and properties are.
2. Properties of inductors in AC circuits.
3. Understand inductance phase shift.
4. Understand inductance reactance factors.
5. Understand inductance impedance factors.
6. Understand inductance resistive AC circuit properties.
7. Understand voltages in series AC circuits.
8. Understand resistive – capacitive series circuit properties.
9. Understand resistive – inductance - capacitive circuit properties.

Advanced Electrical – Volume 17, Unit 3
Power in AC Circuits

1. Electrical power in AC and DC circuits.
2. Understanding RMS values.
3. Understanding capacitive phase shift.
4. Understanding inductive phase shift.
5. Understanding apparent -vs- real power.
6. Finding power in AC circuits (calculating).

Advanced Electrical – Volume 17, Unit 4
Electrical Troubleshooting Using the ESTD

1. Be able to identify and understand common control schemes used in the factory.
2. Be able to troubleshoot common failures in control schemes using the ESTD.
3. Be able to take accurate measurements of voltage, current, or resistance using the Digital Multimeter on the ESTD.
4. Understand how common factory sensing devices work and be able to troubleshoot common faults in their control scheme.
5. Know the difference between two-wire vs. three-wire control schemes.
6. Understand how relay control schemes function and be able to troubleshoot them effectively.

Advanced Electrical – Volume 17, Unit 5
Troubleshooting AC Motors

1. Understand the principle of operation of an AC motor.
2. Be able to identify and troubleshoot common failures in AC motors.
3. Understand how an AC motor is set up with a Wye-Delta configuration.
4. Be able to calculate a Wye-Delta configuration.
5. Be able to identify and troubleshoot common failures in Wye and Delta configurations.
6. Be familiar with the troubleshooting charts for AC motors.

Advanced Electrical – Volume 17, Unit 6
Troubleshooting DC Motors

1. Understand the principle of operation of a DC motor.
2. Be able to identify and troubleshoot common failures in DC motors.
3. Be familiar with the troubleshooting charts for DC motors.

Pump Maintenance – Volume 18, Unit 1
Pump Maintenance

1. Understand the concepts about pumps.
2. Understand the types of pumps and their classification.
3. Learn the main causes of pump failure.
4. Be familiar with the general steps of pump assembly and disassembly.
5. Be familiar with the procedures relating to pump maintenance.

Advanced Machine Adjustment Fundamentals Using the Packaging Machine Simulator – Volume 21, Unit 1
Troubleshooting, Problem Solving, and Problem Identification Techniques

1. Be familiar with the principles of problem solving.
2. Be familiar with problem description and downtime reports.
3. Be familiar with possible and probable cause.
4. Be familiar with corrective procedures and solution verification.
5. Be familiar with troubleshooting charts.
6. Make up a troubleshooting chart.
7. Practice using problem solving techniques.

Advanced Machine Adjustment Fundamentals Using the Packaging Machine Simulator – Volume 21, Unit 2
Set Up Machine Standards Using the Packaging Machine Simulator

1. Be familiar with problem solving techniques as they apply to multiple systems.
2. Be familiar with the construction of the Packaging Machine Simulator.
3. Be familiar with the mechanical, pneumatic, and electric functions of the PMS.
4. Be familiar with the operating standards of the Packaging Machine Simulator.
5. Be familiar with the major types of machine adjustments.
6. Set the Packaging Machine Simulator to operating standards.
7. Chart the timing of the Packaging Machine Simulator.

Advanced Machine Adjustment Fundamentals Using the Packaging Machine Simulator – Volume 21, Unit 3
Problem Solving on Multiple Systems Using the Packaging Machine Simulator

1. Be familiar with troubleshooting charts for the Packaging Machine Simulator.
2. Describe and solve adjustment problems on the Packaging Machine Simulator.
3. Be familiar with the significance of settings and tolerances.
4. Determine the range of tolerances for different systems within the Packaging Machine Simulator.
5. Be familiar with Machine Standards Records.
6. Complete Machine Standards Records for the Packaging Machine Simulator.

PLC Ladder Logic – Volume 22, Unit 1
Introduction to the PLC

1. Discuss the history of programmable logic controllers.
2. Understand relays and why they were replaced.
3. List and describe typical uses of programmable controllers.
4. Traditional PLC concepts.
5. List and describe the primary elements which make up a programmable logic controller.
6. How to organize your project.
7. Introduction to digital I/O.
8. Be familiar with PLC application considerations.
9. Be familiar with memory data types.

PLC Ladder Logic – Volume 22, Unit 2
Introduction to the Logix 5000 System

1. Introduce Boolean Logic.
2. Introduce and explore If Then Statements.
3. Introduce RS Logix 5000.
4. Exploring RS Logix 5000.
5. Creating and Editing Ladder Logic in RS Logix 5000.
6. Introduce and be familiar with an Instruction Library.
7. Be familiar with communications in RS Linx Classic.

PLC Ladder Logic – Volume 22, Unit 3
Introduction and Uses of Databases

1. Be familiar with Controller tags.
2. Be familiar with Program tags.
3. Be familiar with User defined data types.
4. Be familiar with Array Matrix Applications.

PLC Ladder Logic – Volume 22, Unit 4
Instructor Led Programming Demonstration

1. Create, plan, and execute ladder diagram logic used to create a programmable logic controller program.
2. List and define the categories of instructions used in ladder language.
3. Identify a ladder rung and describe how control is accomplished through its use.

PLC Ladder Logic – Volume 22, Unit 5
Instructor Led Programming Labs

1. Be familiar with Hands-On Programming.
2. Be familiar with Online Edits.
3. Execute a Hands-On lab.
4. Be familiar with Motor start / stop push button (PB) station.
5. Be familiar with Hand / Off / Auto labels

PLC Ladder Logic – Volume 22, Unit 6
Hands-On Lab: Timers

1. Be familiar with Use and Application of Timers.
2. Be familiar with If / Then statements.
3. Be familiar with If or Then statements.
4. Be familiar with If Then / If or Then statements.
5. Be familiar with If Then / If Not or Then statements.

PLC Ladder Logic – Volume 22, Unit 7
Hands-On Lab: Counters

1. Be familiar with Counter statements.
2. Be familiar with If Then Counter statements.
3. Be familiar with If or Then Counter statements.
4. Be familiar with If or Counter Then statements.
5. Be familiar with If Not or Then Counter statements.

PLC Ladder Logic – Volume 22, Unit 8
Hands-On Lab: Move and Compare

1. Be familiar with MOV instruction.
2. Be familiar with Compare instruction.

PLC Ladder Logic – Volume 22, Unit 9
Hands-On Lab: Math Functions

1. Be familiar with Math functions.
2. Be familiar with Divide by Zero function.

PLC Ladder Logic – Volume 22, Unit 10
Qualifying Project: Final Exam

1. Execute a Defined Qualifying Project.

Advanced Process Control – Volume 24, Unit 1
Introduction to Process Control Systems

1. Understand the concept of process automation.
2. Understand the elements making up a process.
3. Understand a "loop".
4. Understand the categories of instrumentation.

Advanced Process Control – Volume 24, Unit 2
Introduction to Pressure

1. Understand the physical properties of pressure.
2. Understand the mechanical means to measure pressure.
3. Understand the electronic means to measure pressure.
4. Understand the types of pressure switches.
5. Understand how to calibrate a pressure device.
6. Understand differential pressure.
7. Understand measuring flow using pressure.
8. Understand signal conditioning.

Advanced Process Control – Volume 24, Unit 3
Level

1. Understand the physical properties of pressure.
2. Understand the mechanical means to measure pressure.
3. Understand using electronic means for level.
4. Understand reference points in level.

Advanced Process Control – Volume 24, Unit 4
Flow

1. Understand the properties of flow.
2. Understand the types of flow devices.
3. Understand required installation requirements of flow devices.

Advanced Process Control – Volume 24, Unit 5
Temperature

1. Understand temperature.
2. Understanding mechanical means of measuring temperature.
3. Understanding electronic means of measuring temperature.
4. Understanding temperature device applications.
5. Understanding temperature device protection.

Advanced Process Control – Volume 24, Unit 6
Analytical

1. Understanding pH.
2. Understanding pH measurement.
3. Understanding pH calibration.
4. Understand Turbidity.

Advanced Process Control – Volume 24, Unit 7
Valve Actuators and Positioners

1. Understanding actuators.
2. Understanding positioners.
3. Understanding mode failure.
4. Understanding I/P conversion.
5. Understanding Smart Technology.

Advanced Process Control – Volume 24, Unit 8
Variable Frequency Drive (VFD)

1. Understand Variable Frequency Drives.
2. Understand VFD controls.
3. Understand VFD installation.
4. Understand harmonics.
5. Understand safety and startup of VFD.

Advanced Process Control – Volume 24, Unit 9
Heat Exchangers, Dampers, and Louvers

1. Understand fluid dynamics.
2. Understand exchanger types.
3. Understand exchanger properties.
4. Understand damper properties.
5. Understanding types of dampers.

Advanced Process Control – Volume 24, Unit 10
Hazardous Applications

1. Understand safety.
2. Understand fire triangle.
3. Understand fire codes and class codes.
4. Understand safety methods.
5. Understand explosion proof installations.
6. Understand types of explosion proof devices.
7. Understanding electronic shielding.

Advanced Process Control – Volume 24, Unit 11
Installation and Calibration

1. Understanding calibration versus range.
2. Understanding calibration techniques.