NIDA CORPORATION
COMPUTER ASSISTED INSTRUCTION

LESSON AND OBJECTIVE LISTING

Master Course Listing

2020-03-20

Representative
Technology Education Concepts
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OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE CARDS/KITS

MOD 0 - INTRODUCTION

1011-112-130 Introduction to CAI . . . . . ---
- Recognize interface tools to include keyboard, mouse, stylus, and finger.
- Identify types of interaction available in a CAI lesson.
- Become familiar with lesson structure.
- Understand types of pages and their purpose.

1011-114-130 Training Equipment Familiarization 2
- Identify the power requirements for the Nida trainer.
- Identify the two trainer panels.
- Recognize trainer controls, switches, and indicating devices.
- Identify an experiment card.
- Describe insertion and removal procedures.
- Insert and remove an experiment card.
- Perform procedures to end an experiment.
- Perform procedures to start an experiment.
- Insert and remove an experiment card.
- Perform procedures to end an experiment.

1011-120-130 Safety Practices . . . . . ---
- Understand the nature of electric shock.
- Understand the effects of electric shock.
- Know how to prevent electrical hazards.
- Know how to provide treatment for electrical shock.
- Know how to work on an energized circuit.
- Know how to suppress fires.
- Recognize safety colors.
- Follow hand and power tool precautions.

1011-120-160 Electrostatic Sensitive Devices . . . . . ---
- Define an electrostatic sensitive device.
- Describe the sources of electrostatic discharge and list its hazards to electronic components.
- Identify the static-producing materials in the work area.
- Explain the principles of static control and methods employed in developing static control facilities.
- Describe the special handling, identification, packaging, and protection requirements for electrostatic sensitive devices.

MOD 1 - INTRODUCTION TO ELECTRICITY

5021-112-130 Metric Notation . . . . . ---
- Convert decimal numbers to powers of ten and vice versa.
- Convert decimal numbers to metric prefixes and vice versa.
- Add, subtract, multiply, and divide powers of ten.
- Add, subtract, multiply, and divide metric prefixes.

5021-112-160 Voltage and Current . . . . . ---
- Describe an atom and its structure.
- Define electric charge as it relates to electrons and protons.
- Describe the law of electrostatic force.
- Define voltage and the volt as a unit of voltage.
- Define the relationship between voltage and potential difference.

LESSON ID/TITLE CARDS/KITS

MOD 1 - INTRODUCTION TO ELECTRICITY (cont.)

5021-112-160 Voltage and Current (cont.)
- Identify six ways of producing voltage.
- Define current and the ampere as a unit of current.
- Describe a conductor and the behavior of electrons within a conductor.
- Describe an insulator and the behavior of the electrons within an insulator.
- Identify the three basic parts of an electrical circuit.
- Describe an electrical circuit load and its relationship to the flow of current.

5021-112-190 Resistors . . . . . ---
- Identify the purpose of a resistor.
- Identify the unit of resistance as the ohm.
- Identify the resistor reference designator code.
- Identify resistor schematic symbols.
- Identify fixed resistors.
- Identify variable resistors.
- Define power rating.
- Define tolerance.
- Identify number/letter codes.

5021-112-220 Switches, Fuses, and Circuit Breakers . . . . . ---
- Identify the purpose of a switch.
- Identify switch schematic symbols.
- Describe Single and Double Pole.
- Describe Single and Double Throw.
- Describe four types of switches.
- Identify the schematic symbol for each switch.
- Identify the purpose of protection devices.
- Identify a fuse and a circuit breaker.
- Identify schematic symbols for fuses and circuit breakers.

5021-112-250 Tools for Electronic Troubleshooting . . . . . ---
- Identify the basic hand tools used for troubleshooting and repair.
- Describe the types of tasks performed with each tool.
- Describe the safe and proper use of hand tools.

5021-112-280 Schematic Diagrams . . . . . ---
- Understand the purpose of a schematic diagram.
- Understand general concepts concerning schematic diagrams.

5021-112-920 Introduction to Electricity Post-Test (Theory) . . . . . ---

MOD 2 - MULTIMETER MEASUREMENTS

5021-114-130 Magnetism, Relays, and Meters . . . . . ---
- Define magnetism.
- Identify characteristics of magnets.
- Define laws of magnetic attraction and repulsion.
- Describe properties of magnetic lines of force.
- Identify non-magnetic materials.
- Define electromagnetism.
- Identify the characteristics of electromagnetism.
- Describe the operation of a relay.

LESSON ID/TITLE CARDS/KITS

MOD 2 - MULTIMETER MEASUREMENTS (cont.)

5021-114-130 Magnetism, Relays, and Meters (cont.)
- ▪ Describe the operation of a magnetic circuit breaker.
- ▪ Describe the operation of a meter.

5021-114-160 Introduction to Multimeters . . . . . ---
- ▪ Identify the quantities measured by multimeters.
- ▪ Identify multimeter characteristics.
- ▪ Describe the functional sections of a digital multimeter.
- ▪ Describe the purpose of each functional section.

5021-114-190 Multimeter Use . . . . . CF
- ▪ Understand how to operate a digital multimeter.
- ▫ Operate a digital multimeter.

5021-114-200 Analog Meters . . . . . ---
- ▪ Identify the quantities measured by multimeters.
- ▪ Identify multimeter characteristics.
- ▪ Describe the functional sections of a digital multimeter.
- ▪ Describe the purpose of each functional section.

5021-114-220 Voltage Measurements 2
- ▪ Describe how to set up a digital multimeter to measure voltage.
- ▪ Understand how to read a digital multimeter's display when measuring voltage.
- ▪ Describe the correct way to connect a multimeter to a circuit for measuring voltage.
- ▫ Perform voltage measurements with a digital multimeter.

5021-114-250 Current Measurements 4A
- ▪ Describe how to set up a digital multimeter to measure current.
- ▪ Describe how to read a digital multimeter's display when measuring current.
- ▪ Describe the correct way to connect a multimeter to a circuit for measuring current.
- ▪ Identify the precautions to observe when making current measurements.
- ▫ Perform current measurements with a digital multimeter.

5021-114-280 Resistance Measurements 4A
- ▪ Describe how to set up a digital multimeter to measure resistance.
- ▪ Understand how to read a digital multimeter's display when measuring resistance.
- ▪ Describe the correct way to connect a multimeter to a circuit for measuring resistance.
- ▪ Identify the precautions to observe when making resistance measurements.
- ▫ Perform resistance measurements with a digital multimeter.

5021-114-920 Multimeter Use Post-Test (Theory) . . . . . ---

5021-114-960 Multimeter Use Post-Test (Performance) 2W*, 4AW*
- ▫ Demonstrate the ability to properly set up a circuit and follow safety precautions.
- ▫ Demonstrate the ability to use a multimeter to measure voltage, current, and resistance.

MOD 3 - BASIC DC CIRCUITS

5021-116-130 Ohm's Law and Power 5
- ▪ Define Ohm's Law and describe how voltage, current, and resistance are related.
- ▪ Define power and describe how voltage, current, and Ohm's Law are related to power.
- ▫ Prove the Ohm's Law relationship of voltage, current, and resistance.

5021-116-160 Series Circuits 6A
- ▪ Identify a series circuit.
- ▪ Calculate total resistance in a series circuit.

LESSON ID/TITLE CARDS/KITS

MOD 3 - BASIC DC CIRCUITS (cont.)

5021-116-160 Series Circuits (cont.)
- ▪ Calculate current in a series circuit.
- ▪ Calculate voltage drops across resistance.
- ▫ Measure current values in a series circuit.
- ▫ Measure voltage drops in a series circuit.

5021-116-190 Series Circuit Troubleshooting Theory . . . . . ---
- ▪ Follow a logical troubleshooting procedure.
- ▪ Identify an open, short, and a changed value component in a series circuit.
- ▪ Analyze a series circuit and determine if the circuit is defective.

5021-116-220 Series Circuit Troubleshooting Experiment 6A
- ▫ Determine if a series circuit is open and identify which component is open.
- ▫ Determine if a series circuit has a short and identify which component is shorted.
- ▫ Determine if a series circuit has a changed value and identify which resistor has a changed value.

5021-116-250 Series Circuit Troubleshooting Practice 6A
- ▫ Troubleshoot a series circuit and identify if the circuit is operating properly.
- ▫ Identify a faulted circuit as being open, shorted, or changed value.
- ▫ Identify the component most likely to cause the fault.

5021-116-280 Parallel Circuits 8A
- ▪ Identify a parallel circuit.
- ▪ Recognize that the applied voltage is the same across each branch.
- ▪ Calculate current in each branch of a parallel circuit.
- ▪ Calculate total current from the sum of the individual branches of a parallel circuit.
- ▪ Calculate total resistance in a parallel circuit.
- ▫ Measure the applied voltage across each branch in a parallel circuit.
- ▫ Measure current across each branch in a parallel circuit.
- ▫ Measure total resistance in a parallel circuit.

5021-116-310 Parallel Circuit Troubleshooting Theory . . . . . ---
- ▪ Identify an open, short, and changed value component in a parallel circuit.
- ▪ Analyze a parallel circuit and determine if the circuit is defective.

5021-116-340 Parallel Circuit Troubleshooting Experiment 8A
- ▫ Determine if a parallel circuit is open and identify which component is open.
- ▫ Determine if a parallel circuit has a short and identify which component is shorted.
- ▫ Determine if a parallel circuit has a changed value and identify which resistor has changed value.

5021-116-370 Parallel Circuit Troubleshooting Practice 8A
- ▫ Troubleshoot a parallel circuit and identify if the circuit is operating properly.
- ▫ Identify a faulted circuit as being open, shorted, or changed value.
- ▫ Identify the component most likely to cause the fault.

5021-116-400 Series-Parallel Circuits 9A
- ▪ Identify a series-parallel circuit.
- ▪ Calculate total resistance in a series-parallel circuit.
- ▪ Calculate current in a series-parallel circuit.
- ▪ Calculate voltage drops in a series-parallel circuit.
- ▫ Measure resistance values in a series-parallel circuit.
- ▫ Measure current values in a series-parallel circuit.
- ▫ Measure voltage drops in a series-parallel circuit.

LESSON ID/TITLE — CARDS/KITS

MOD 3 - BASIC DC CIRCUITS (cont.)

5021-116-430 Series-Parallel Circuit Troubleshooting Theory . . . . . ---
- ▪ Identify an open, short, and changed value component in a series-parallel circuit.
- ▪ Analyze a series-parallel circuit and determine if the circuit is defective.

5021-116-460 Series-Parallel Circuit Troubleshooting Experiment 9A
- ▫ Determine if a series-parallel circuit is open and identify which component is open.
- ▫ Determine if a series-parallel circuit has a short and identify which component is shorted.
- ▫ Determine if a series-parallel circuit has a changed value and identify which component has a changed value.

5021-116-490 Series-Parallel Circuit Troubleshooting Practice 9A
- ▫ Troubleshoot a series-parallel circuit and identify if the circuit is operating properly.
- ▫ Identify a faulted circuit as being open, shorted, or changed value.
- ▫ Identify the component most likely to cause the fault.

5021-116-920 Basic DC Circuits Post-Test (Theory) . . . . . ---

5021-116-960 Basic DC Circuits Post-Test (Performance) 9AW*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a circuit is working properly using voltage, current, and resistance measurements.
- ▫ Demonstrate the ability to troubleshoot a circuit using voltage, current, and resistance measurements.

MOD 4 - COMPLEX DC CIRCUITS

5021-118-130 Voltage Divider Circuits 9C
- ▪ Identify a voltage divider circuit.
- ▪ Identify a voltage divider as being loaded or unloaded.
- ▪ Calculate voltage, current, and resistance for loaded and unloaded voltage dividers.
- ▪ Calculate % regulation for a voltage divider circuit.
- ▫ Measure unloaded voltage divider voltages.
- ▫ Measure loaded voltage divider voltages.

5021-118-160 Bridge Circuits 10A
- ▪ State the purpose of a bridge circuit.
- ▪ Identify a bridge circuit.
- ▪ Solve for voltage outputs.
- ▪ Solve for unknown resistance.
- ▫ Voltage measurements.
- ▫ Resistance measurements.

5021-118-190 Introduction to Kirchhoff's Voltage and Current Laws 9C
- ▪ Identify a complex circuit.
- ▪ State Kirchhoff's Current Law.
- ▪ State Kirchhoff's Voltage Law.
- ▫ Compare calculated and measured voltage in a circuit using Kirchhoff's Laws.

5021-118-220 Kirchhoff's Voltage and Current Laws 9C
- ▪ Identify a complex circuit.
- ▪ State Kirchhoff's current law.
- ▪ State Kirchhoff's voltage law.
- ▪ Calculate current using Kirchhoff's laws.

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MOD 4 - COMPLEX DC CIRCUITS (cont.)

5021-118-220 Kirchhoff's Voltage and Current Laws (cont.)
- ▪ Calculate voltage using Kirchhoff's laws.
- ▫ Compare calculated and measured voltage in a circuit using Kirchhoff's Laws.

5021-118-250 Norton's Theorem . . . . . ---
- ▪ Describe the purpose of Norton's Theorem.
- ▪ Describe the procedure in solving circuits using Norton's Theorem.
- ▪ Nortonize a series-parallel circuit.

5021-118-280 Thevenin's Theorem . . . . . ---
- ▪ Describe the purpose of Thevenin's Theorem.
- ▪ Describe the 6-step process in solving circuits using Thevenin's Theorem.
- ▪ Thevenize a series-parallel circuit.
- ▪ Thevenize a complex circuit.

5021-118-310 Multimeter Loading 9C
- ▪ Describe the circuit loading effect of multimeters.
- ▪ Describe how the multimeter loading is reduced.
- ▪ Describe the Ohms per volt rating of analog multimeters.
- ▫ Measure circuit voltages using an analog and digital multimeter.
- ▫ Observe the loading effect of an analog multimeter.

5021-118-920 Complex DC Circuits Post-Test (Theory) . . . . . ---

5021-118-960 Complex DC Circuits Post-Test (Performance) 9CW*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a voltage divider circuit is working properly using voltage and resistance measurements.

MOD 5 - WIRING

5021-214-130 PCB Component Insertion/Extraction Techniques . . . . . ---
- ▪ Identify the general characteristics of PC boards.
- ▪ Identify several connection methods used on PC boards.
- ▪ Identify the general techniques for inserting components into PC boards.
- ▪ Identify common faults which may occur when installing components on PC boards.
- ▪ Identify the general techniques for extracting components from PC boards.
- ▪ Identify general techniques for repairing PC board traces and pads.

5021-214-160 Basic Soldering Techniques . . . . . ---
- ▪ Identify different types of solder and flux.
- ▪ Select the correct soldering iron for a particular task.
- ▪ Know how to properly prepare a wire for soldering.
- ▪ Understand how to make a "Western Union" splice.
- ▪ Identify different types of wire terminals and their connection methods.
- ▪ Know how to make reliable solder connections.
- ▪ Understand how to correct poor solder connections.

5021-214-190 Basic Connector Termination Techniques . . . . . ---
- ▪ Identify standard wire gauges.
- ▪ Identify types of wire and cable.
- ▪ Understand how cables and wires are typically used.
- ▪ Understand basic connector termination techniques.

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MOD 5 - WIRING (cont.)

5021-214-190 Basic Connector Termination Techniques (cont.)
- Understand the correct method of terminating banana plugs, crimp connectors and BNC connections.
- Know which skills are required to make routine repairs to electronic equipment.

5021-214-220 Basic Wire Wrapping Techniques . . . . . ---
- Understand wire wrapping terminology.
- Identify common types of wire wraps.
- Identify common wire wrap tools.
- Recognize the characteristics of good wire wrap.
- Understand the procedure for making good wire wrap connections.
- Recognize common wire wrapping faults.

5021-214-250 Basic Wiring and Connector Troubleshooting Theory . . . . . ---
- Follow a logical troubleshooting procedure.
- Describe open circuit measurements.
- Describe short circuit measurements.
- Describe changed value measurements.
- Understand cable and connector labeling.
- Describe how to make continuity checks of shielded and unshielded cables.

5021-214-280 Wire Troubleshooting w1, w2, w3
- Determine if a wire is open and identify which wire is open using continuity checks.
- Determine if a wire is shorted and identify which wire is shorted using continuity checks.
- Determine if a wiring circuit has a changed value and identify the component that has changed value using continuity checks.
- Find an open and short using voltage and current measurements.

5021-214-920 Wiring Post-Test (Theory) . . . . . ---

5021-214-960 Wiring Post-Test (Performance) w1w*, w2w*, w3w*
- Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- Demonstrate the ability to determine if a wiring harness is working properly using voltage and resistance measurements.

MOD 6 - INTRODUCTION TO AC CIRCUITS

5021-312-130 Alternating Current . . . . . ---
- Define alternating current.
- Identify an AC sine wave.
- Define frequency and cycle.
- Define the unit Hertz.
- Determine the wavelength of a sine wave.
- Determine the period of a sine wave.

5021-312-160 Generating AC Electricity . . . . . ---
- Define the characteristics of induction.
- Determine magnitude and polarity of voltage produced in a magnetic field.
- Explain the operation of an AC generator.
- Identify values of voltage and current at various electrical degrees.
- Calculate peak, peak-to-peak, average, and RMS values.
- Identify in and out of phase.

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MOD 6 - INTRODUCTION TO AC CIRCUITS (cont.)

5021-312-160 Generating AC Electricity (cont.)
- Identify magnitude and degree of an AC wave using vectors.

5021-312-190 Non-Sinusoidal Waves ... ---
- Identify harmonic frequencies.
- Identify harmonic frequencies used to produce non-sinusoidal waves.
- Define square waves.
- Identify square wave cycles.
- Define ramp waveforms.
- Identify ramp waveforms.

5021-312-220 Resistance in AC Circuits ... ---
- Use Ohm's Law to determine resistance in an AC series circuit.
- Identify the relationship between voltage, current, and resistance in an AC series circuit.
- Use Ohm's Law to determine resistance in an AC parallel circuit.
- Identify the relationship between voltage, current, and resistance in an AC parallel circuit.
- Use Ohm's Law to determine resistance in an AC series-parallel circuit.
- Identify the relationship between voltage, current, and resistance in an AC series-parallel circuit.

5142-310-130 Magnetism and Electromagnetic Principles ... 182, 183
- Define magnetism.
- Describe different types of magnetism.
- Describe relays, motors, transformers, and generators.
- Observe magnetic poles.
- Demonstrate temporary magnets.
- Examine electromagnetic operation.
- Demonstrate an application of magnetism.

5142-310-160 Magnetic Calculations ... ---
- Describe properties of magnetic lines of force.
- Identify magnetic and non-magnetic materials.
- Identify the characteristics of electromagnetism.
- Calculate magnetomotive force.
- Calculate magnetic field strength.
- Determine force.
- Determine torque.

5021-312-920 Introduction to AC Post-Test (Theory) ... ---

MOD 7 - AC TEST EQUIPMENT

5020-314-130 Introduction to Oscilloscopes ... ---
- Describe the purpose of an analog oscilloscope.
- Identify the quantities measured by an oscilloscope.
- Identify different types of oscilloscopes.
- Identify the four major functional sections of an oscilloscope.
- Describe the purpose of each control and switch.
- Describe the purpose of a digital oscilloscope.
- Identify the quantities measured by an oscilloscope.
- Identify the four major functional sections of a digital oscilloscope.
- Describe the purpose of menus and controls.

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MOD 7 - AC TEST EQUIPMENT (cont.)

5020-314-190 Oscilloscope Use with Function Generator 10
- ▫ Set up an oscilloscope for normal use.
- ▫ Measure voltage using an oscilloscope.
- ▫ Measure frequency using an oscilloscope.
- ▫ Set up an oscilloscope for normal use.
- ▫ Measure voltage using an oscilloscope.
- ▫ Measure frequency using an oscilloscope.
- ▫ Set up an oscilloscope for normal use.
- ▫ Measure voltage using an oscilloscope.
- ▫ Measure frequency using an oscilloscope.
- ▫ Save and recall a waveform using the storage function of an oscilloscope.

5020-314-430 Introduction to the Function Generator . . . . . ---
- ▪ Describe the purpose of a function generator.
- ▪ Identify the types of output signals generated by a function generator.
- ▪ Identify the three major sections of a function generator.
- ▪ Describe the purpose of each control and switch on a function generator.

5020-314-460 Function Generator Use 10
- ▫ Set up a function generator for normal operation.
- ▫ Adjust a function generator for various output signals.
- ▫ Modulate an output signal.

5020-314-730 Introduction to the Frequency Counter . . . . . ---
- ▪ Describe the purpose of a frequency counter.
- ▪ Describe the four major functions a frequency counter performs.
- ▪ Determine the quantity measured from the display.
- ▪ Identify the controls of a frequency counter and their purpose.

5020-314-760 Frequency Counter Use 10
- ▫ Set up a frequency counter for normal operation.
- ▫ Perform check, period, frequency, and totalize measurements.
- ▫ Compare frequency and period measurements using a frequency counter and an oscilloscope.

5020-314-920 AC Test Equipment Post-Test (Theory) . . . . . ---

5020-314-960 AC Test Equipment Post-Test (Performance) 10w*
- ▫ Demonstrate the ability to properly set up a circuit and follow safety precautions.
- ▫ Demonstrate the ability to use an oscilloscope to make voltage and frequency measurements.

MOD 8 - INDUCTANCE AND RL CIRCUITS

5021-316-130 Introduction to Inductors . . . . . ---
- ▪ Identify types of inductors.
- ▪ Describe the current opposing characteristic of an inductor.
- ▪ Identify the schematic symbol for an inductor.
- ▪ Identify characteristics of inductance.
- ▪ Identify the unit of measurement for inductance.

5021-316-160 Inductor Identification 11
- ▫ Identify inductors.
- ▫ Identify inductor color codes.

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MOD 8 - INDUCTANCE AND RL CIRCUITS (cont.)

5021-316-190 RL Series Circuits . . . . . ---
- ▪ Calculate total inductance in series circuits.
- ▪ Calculate total inductive reactance in series circuits.
- ▪ Calculate total impedance in series circuits.

5021-316-220 RL Series Circuit Operation 13
- ▫ Measure the inductive phase relationship between voltage and current.
- ▫ Verify normal operation of an RL series circuit.
- ▫ Measure the phase relationship between the voltages developed across resistors and inductors.

5021-316-250 RL Series Circuit Troubleshooting Experiment 16B
- ▪ Identify an open component in an RL series circuit.
- ▪ Identify a shorted component in an RL series circuit.
- ▪ Identify a changed value component in an RL series circuit.
- ▫ Observe an open component in an RL series circuit.
- ▫ Observe a shorted component in an RL series circuit.

5021-316-310 RL Parallel Circuits . . . . . ---
- ▪ Calculate total inductance in RL parallel circuits.
- ▪ Calculate total inductive reactance in RL parallel circuits.
- ▪ Calculate total impedance in RL parallel circuits.

5021-316-340 RL Parallel Circuit Operation 13
- ▫ Measure the current phase difference between the inductive and resistive branches of a parallel RL circuit.
- ▫ Verify normal operation of a parallel RL circuit.
- ▫ Measure the total current phase difference in a parallel RL circuit.

5021-316-370 RL Parallel Circuit Troubleshooting Experiment 16B
- ▪ Identify an open component in an RL parallel circuit.
- ▪ Identify a shorted component in an RL parallel circuit.
- ▪ Identify a changed value component in an RL parallel circuit.
- ▫ Observe an open component in an RL parallel circuit.
- ▫ Observe a shorted component in an RL parallel circuit.

5021-316-430 RL Filters 16B
- ▪ Identify RL filter circuits.
- ▪ Describe RL filter circuit characteristics.
- ▪ Calculate RL filter circuit values.
- ▫ Measure RL filter circuit values.
- ▫ Compare measured RL filter circuit values with calculated circuit values.

5021-316-920 Inductance and RL Circuits Post-Test (Theory) . . . . . ---

5021-316-960 Inductance and RL Circuits Post-Test (Performance) 16BW*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if an RL circuit is working properly using voltage measurements made using an oscilloscope.

MOD 9 - CAPACITANCE AND RC CIRCUITS

5021-318-130 Introduction to Capacitors . . . . . ---
- ▪ Identify types of capacitors.

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MOD 9 - CAPACITANCE AND RC CIRCUITS (cont.)

5021-318-130 Introduction to Capacitors (cont.)
- ▪ Describe charge and discharge characteristics of a capacitor.
- ▪ Identify the schematic symbol for a capacitor.
- ▪ Identify characteristics of capacitance.
- ▪ Identify the unit of measurement for capacitance.

5021-318-160 Capacitor Identification 11
- ▫ Identify ceramic, film, mica, and electrolytic capacitors.
- ▫ Read the capacitance and voltage values.

5021-318-190 RC Series Circuits . . . . . ---
- ▪ Calculate total capacitance in series circuits.
- ▪ Calculate total capacitive reactance in series circuits.
- ▪ Calculate total impedance in series circuits.

5021-318-220 RC Series Circuit Operation 12
- ▫ Measure the capacitive phase relationship between voltage and current.
- ▫ Verify normal operation of an RC series circuit.

5021-318-250 RC Series Circuit Troubleshooting Experiment 14A
- ▪ Identify an open component in an RC series circuit.
- ▪ Identify a shorted component in an RC series circuit.
- ▪ Identify a changed value component in an RC series circuit.
- ▫ Observe an open component in an RC series circuit.

5021-318-340 RC Parallel Circuits . . . . . ---
- ▪ Calculate total capacitance in a parallel circuit.
- ▪ Calculate total capacitive reactance in a parallel circuit.
- ▪ Calculate total impedance in a parallel circuit.

5021-318-370 RC Parallel Circuit Operation 12
- ▫ Measure the phase difference between the capacitive and resistive branches.
- ▫ Verify normal circuit operation.
- ▫ Measure the total current phase difference.

5021-318-400 RC Parallel Circuit Troubleshooting Experiment 14A
- ▪ Identify an open component in an RC parallel circuit.
- ▪ Identify a shorted component in an RC parallel circuit.
- ▪ Identify a changed value component in an RC parallel circuit.
- ▫ Observe an open component in an RC parallel circuit.
- ▫ Observe a shorted component in an RC parallel circuit.

5021-318-490 RC Filters 14B, 14A
- ▪ Identify RC filter circuits.
- ▪ Describe RC filter circuit characteristics.
- ▪ Calculate RC filter circuit values.
- ▫ Measure RC low pass filter circuit values.
- ▫ Compare measured RC low pass filter circuit values with calculated circuit values.
- ▫ Measure RC high pass filter circuit values.
- ▫ Compare measured RC high pass filter circuit values with calculated circuit values.

5021-318-920 Capacitance and RC Circuits Post-Test (Theory) . . . . . ---

5021-318-960 Capacitance and RC Circuits Post-Test (Performance) 14AW*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.

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MOD 9 - CAPACITANCE AND RC CIRCUITS (cont.)

5021-318-960 Capacitance and RC Circuits Post-Test (Performance) (cont.)
- ▫ Demonstrate the ability to determine if an RC circuit is working properly using voltage measurements made using an oscilloscope.

MOD 10 - RC TIME CONSTANTS AND TRANSIENTS

5021-320-130 RC and RL Time Constants . . . . . ---
- ▪ Describe RC time constants.
- ▪ Calculate the amount of charge or discharge of a capacitor using RC time constants.
- ▪ Describe RL time constants.
- ▪ Calculate the amount of current present in an inductor using RL time constants.

5021-320-160 RC Time Constants Operation 15
- ▫ Observe capacitor charging and discharging using a multimeter.
- ▫ Observe capacitor charging and discharging using an oscilloscope.
- ▫ Verify RC time constants by the use of measurements.

5021-320-190 RC Circuit Transient Analysis . . . . . ---
- ▪ Describe the effects a capacitor has on non-sinusoidal waveshapes.
- ▪ Describe how long and short RC time constants affect waveshapes.
- ▪ Describe how RC time constants relate to capacitive reactances.

5021-320-220 RC Circuit Transient Experiment 14A
- ▫ Predict effects on voltage and current as frequency changes.
- ▫ Measure voltage waveform across a capacitor with a square wave applied.
- ▫ Measure current waveform across a capacitor using a sampling resistor.

5021-320-250 RC Circuit Transient Troubleshooting Experiment 14A
- ▪ Describe typical faults in an RC transient circuit.
- ▪ Describe RC circuit transient troubleshooting procedures.
- ▪ Describe the effects of open, shorted, and changed value components.
- ▫ Recognize that an RC transient circuit is faulted.
- ▫ Observe the effects of an open and shorted component in an RC transient circuit.

5021-320-920 RC Time Constants and Transients Post-Test (Theory) . . . . . ---

5021-320-960 RC Time Constants and Transients Post-Test (Performance) 14BW*, 804W*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to make charge time and period measurements in an RC circuit using an oscilloscope.
- ▫ Demonstrate the ability to determine if an RC circuit is working properly using charge time and period measurements.
- ▫ Demonstrate the ability to troubleshoot an RC circuit using voltage and frequency measurements.

MOD 11 - RESONANCE

5021-322-130 Capacitive/Inductive Reactance and LCR Circuits . . . . . ---
- ▪ Describe the effects of inductors and capacitors when used in the same circuit.
- ▪ Calculate circuit values in a series LCR circuit.
- ▪ Calculate circuit values in a parallel LCR circuit.

5021-322-160 Series and Parallel LCR Circuit Experiment 17, 19
- ▫ Calculate and measure the voltage drops in a series LCR circuit.

LESSON ID/TITLE — CARDS/KITS

MOD 11 - RESONANCE (cont.)

5021-322-160 Series and Parallel LCR Circuit Experiment (cont.)
- ▫ Verify normal operation of a series LCR circuit.
- ▫ Measure the phase relationship between EA, ER, EC, and EL in a series LCR circuit.
- ▫ Calculate and measure the branch currents in a parallel LCR circuit.
- ▫ Verify normal operation of a parallel LCR circuit.
- ▫ Measure the phase relationship between IT, IR, IC, and IL in a parallel LCR circuit.

5021-322-190 LCR Circuit Troubleshooting 18A
- ▪ Identify an open component in a series and parallel LCR circuit.
- ▪ Identify a shorted component in a series and parallel LCR circuit.
- ▪ Identify a changed value component in a series and parallel LCR circuit.
- ▫ Observe the effects of an open component in a series LCR circuit.
- ▫ Observe the effects of a shorted component in a series LCR circuit.

5021-322-220 Series Resonance . . . . . ---
- ▪ Describe series resonance.
- ▪ Calculate the resonant frequency of a series LCR circuit.
- ▪ Describe series LCR circuit values at resonance.

5021-322-250 Series Resonant Circuits 18A
- ▫ Calculate and measure the resonant frequency in a series LCR circuit.
- ▫ Observe the effects of voltage magnification.
- ▫ Observe the values of V, I, and Z below resonance in a series LCR circuit.

5021-322-280 Parallel Resonance . . . . . ---
- ▪ Describe parallel resonance.
- ▪ Calculate the resonant frequency of the parallel LCR circuit.
- ▪ Describe parallel LCR circuit values at resonance.

5021-322-310 Parallel Resonant Circuits 20A
- ▫ Calculate and measure the resonant frequency in a parallel LCR circuit.
- ▫ Observe the values of I and Z below resonance, at resonance, and above resonance in a parallel LCR circuit.

5021-322-340 Resonant Circuit Troubleshooting Experiment 18A, 20A
- ▪ Identify an open component in a resonant circuit.
- ▪ Identify a shorted component in a resonant circuit.
- ▪ Identify a changed value component in a resonant circuit.
- ▫ Observe the effects of an open component in a resonant series and parallel circuit.
- ▫ Observe the effects of a shorted component in a resonant series and parallel circuit.

5021-322-920 Resonance Post-Test (Theory) . . . . . ---

5021-322-960 Resonance Post-Test (Performance) 18AW*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a resonant circuit is working properly using voltage and frequency measurements made with an oscilloscope.
- ▫ Demonstrate the ability to troubleshoot a resonant circuit using voltage and frequency measurements.

MOD 12 - TRANSFORMERS

5021-324-130 Introduction to Transformers . . . . . ---
- ▪ Describe the purpose of transformers.

LESSON ID/TITLE CARDS/KITS

MOD 12 - TRANSFORMERS (cont.)

5021-324-130 Introduction to Transformers (cont.)
- ▪ Identify transformer schematic symbols and the reference designation.
- ▪ Describe transformer operating characteristics.
- ▪ Calculate turn ratio.
- ▪ Calculate secondary voltage, current, and power.
- ▪ Calculate primary current and power.

5021-324-160 Transformer Operation 21
- ▫ Measure primary voltage of a transformer.
- ▫ Measure secondary voltage of a transformer.
- ▫ Determine step-up or step-down transformer action.

5021-324-190 Troubleshooting Transformers 21
- ▪ Describe typical faults in transformer circuits.
- ▪ Describe transformer troubleshooting procedures.
- ▫ Recognize that a transformer is faulted.
- ▫ Observe the effects of an open and shorted secondary in a transformer circuit.

5021-324-920 Transformers Post-Test (Theory) . . . . . ---

5021-324-960 Transformers Post-Test (Performance) 21W*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a transformer circuit is working properly using voltage measurements made using a multimeter.
- ▫ Demonstrate the ability to determine the type of transformer circuit (step up, step down, 1:1) using voltage measurements.
- ▫ Demonstrate the ability to troubleshoot a transformer circuit using voltage measurements.

MOD 13 - RELAYS AND SWITCHES

5021-326-130 Relays . . . . . ---
- ▪ Describe the purpose and types of relays.
- ▪ Describe basic relay construction and operation.
- ▪ Identify the schematic symbol and reference designator for relays.
- ▪ Describe the latched and time delay relay.
- ▪ Describe a solenoid.

5021-326-160 Relay Operation Experiment 84B
- ▫ Trace signal flow through a relay circuit.
- ▫ Measure voltages in a relay circuit.

5021-326-190 Troubleshooting Relays and Switches 84B
- ▪ Describe typical faults in relays.
- ▪ Describe relay troubleshooting procedures.
- ▫ Recognize that a relay circuit is faulted.
- ▫ Identify the fault in a faulted relay circuit.

5021-326-220 Electrical Circuits . . . . . ---
- ▪ Identify component symbols from a schematic drawing.
- ▪ Describe the operation of an electrical circuit using a schematic drawing.

5021-326-250 Electrical Circuits Experiment 82, 83
- ▫ Trace signal flow through an electrical circuit.
- ▫ Measure AC and DC voltages in an electrical circuit.

LESSON ID/TITLE — CARDS/KITS

MOD 13 - RELAYS AND SWITCHES (cont.)

5021-326-280 Electrical Circuits Troubleshooting 82, 83
- ▪ Describe typical faults in an electrical circuit.
- ▪ Describe electrical circuit troubleshooting procedures.
- ▫ Recognize that an electrical circuit is faulted.
- ▫ Identify the fault in a faulted electrical circuit.

5021-326-920 Relays and Switches Post-Test (Theory) . . . . . ---

5021-326-960 Relays and Switches Post-Test (Performance) 84BW*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a relay logic circuit is working properly using voltage measurements.
- ▫ Demonstrate the ability to troubleshoot a relay logic circuit using voltage measurements.

MOD 14 - DIODE AND DIODE CIRCUITS

5021-514-130 Introduction to Diodes . . . . . ---
- ▪ Identify the purpose of a diode.
- ▪ Recognize the common types of diodes.
- ▪ Recognize diode schematic symbols and reference designators.
- ▪ Describe the uses of diodes.
- ▪ Describe semiconductor material.
- ▪ Describe P and N-type semiconductor material.
- ▪ Describe forward and reverse biasing.

5021-514-160 Junction Diodes . . . . . ---
- ▪ Describe the purpose of a junction diode.
- ▪ Identify the schematic symbol for a junction diode.
- ▪ Describe forward and reverse bias.
- ▪ Calculate circuit current based on the knee voltage of the diode.

5021-514-190 Junction Diode Operation 22A
- ▫ Recognize normal operation of a junction diode.
- ▫ Measure current through a junction diode.

5021-514-220 Junction Diode Troubleshooting Experiment 22A
- ▪ Identify an open junction diode circuit.
- ▪ Identify a shorted junction diode in a circuit.
- ▪ Identify a changed value junction diode in a circuit.
- ▫ Observe an open junction diode in a circuit.
- ▫ Observe a shorted junction diode in a circuit.

5021-514-280 Diode Limiter Operation 77A
- ▪ Describe the purpose of diode limiters.
- ▪ Identify the two different types of diode limiter circuits.
- ▪ Describe diode limiter operation.
- ▫ Measure input and output waveforms of diode limiter circuits.
- ▫ Recognize normal operation of diode limiter circuits.

5021-514-310 Diode Clamper Operation 77B
- ▪ Describe the purpose of diode clampers.
- ▪ Identify the two different types of diode clamper circuits.
- ▪ Describe diode clamper operation.

LESSON ID/TITLE — CARDS/KITS

MOD 14 - DIODE AND DIODE CIRCUITS (cont.)

5021-514-310 Diode Clamper Operation (cont.)
- ▫ Measure input and output waveforms of diode clamper circuits.
- ▫ Recognize normal operation of diode clamper circuits.

5021-514-340 Limiter and Clamper Troubleshooting Experiment 77A, 77B
- ▪ Describe typical faults in diode limiter and clamper circuits.
- ▪ Describe diode limiter and clamper troubleshooting procedures.
- ▫ Recognize that a parallel diode limiter circuit is faulted.
- ▫ Observe the effects of a defective diode in a parallel limiter circuit.
- ▫ Recognize that a diode clamper circuit is faulted.
- ▫ Observe the effects of a defective diode in a clamper circuit.

5021-514-400 Electron Tube Principles . . . . . ---
- ▪ Identify the purpose of electron tubes.
- ▪ Describe types, symbols, and characteristics of vacuum tubes, and the function of their elements.
- ▪ Identify electron tube operation principles.
- ▪ Identify electron tube configurations.
- ▪ Identify characteristics of cathode ray tubes (CRTs).
- ▪ Identify cathode ray tube (CRT) operating principles.

5021-514-920 Diodes and Diode Circuits Post-Test (Theory) . . . . . ---

5021-514-960 Diodes and Diode Circuits Post-Test (Performance) 22AW*, 77AW*, 77BW*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a diode switching circuit is working properly using voltage measurements.
- ▫ Demonstrate the ability to troubleshoot a diode switching circuit using voltage measurements.
- ▫ Demonstrate the ability to troubleshoot a diode clamping circuit using voltage measurements.
- ▫ Demonstrate the ability to troubleshoot a diode limiting circuit using voltage measurements.

MOD 15 - TRANSISTOR CIRCUITS

5021-516-130 Introduction to Transistors . . . . . ---
- ▪ Describe the purpose of a transistor.
- ▪ Describe types of transistors.
- ▪ Identify transistor schematic symbols.
- ▪ Identify leads on transistors.
- ▪ Describe the purpose of DC bias in transistors.
- ▪ Describe NPN transistor bias.
- ▪ Describe PNP transistor bias.

5021-516-160 Transistor Operation 28, 29
- ▪ Describe transistor cutoff and saturation.
- ▪ Describe transistor alpha and beta.
- ▪ Identify fixed, self, and combinational biasing.
- ▫ Measure alpha and beta.
- ▫ Observe cutoff and saturation.
- ▫ Measure collector current with varying load resistors.

LESSON ID/TITLE CARDS/KITS

MOD 15 - TRANSISTOR CIRCUITS (cont.)

5021-516-190 Introduction to Transistor Amplifiers . . . . . ---
- ▪ Describe the purpose of an amplifier.
- ▪ Describe classes of amplifier operation.
- ▪ Describe common emitter amplifiers.
- ▪ Describe common collector amplifiers.
- ▪ Describe common base amplifiers.

5021-516-220 Common Emitter Amplifier . . . . . ---
- ▪ Describe the operating characteristics of a common emitter amplifier.
- ▪ Describe the purpose of individual components in a common emitter amplifier.
- ▪ Describe methods to determine class of operation.
- ▪ Describe methods to determine voltage gain.

5021-516-250 Common Emitter Amplifier Experiment 30A
- ▫ Measure the input and output waveforms of a common emitter amplifier circuit to determine normal operation.
- ▫ Observe waveforms in a common emitter amplifier circuit.

5021-516-280 Common Collector Amplifier . . . . . ---
- ▪ Describe the operating characteristics of a common collector amplifier.
- ▪ Describe the purpose of individual components in a common collector amplifier.
- ▪ Describe methods to determine class of operation.
- ▪ Describe methods to determine voltage gain.

5021-516-310 Common Collector Amplifier Experiment 31
- ▫ Measure the input and output waveforms of a common collector amplifier circuit to determine normal operation.
- ▫ Observe waveforms in a common collector amplifier circuit.

5021-516-340 Common Base Amplifier . . . . . ---
- ▪ Describe the operating characteristics of a common base amplifier.
- ▪ Describe the purpose of individual components in a common base amplifier.
- ▪ Describe methods to determine class of operation.
- ▪ Describe methods to determine voltage gain.

5021-516-370 Common Base Amplifier Experiment 32
- ▫ Measure the input and output waveforms of a common base amplifier circuit to determine normal operation.
- ▫ Observe waveforms in a common base amplifier circuit.

5021-516-920 Transistor Circuits Post-Test (Theory) . . . . . ---

5021-516-960 Transistor Circuits Post-Test (Performance) 30AW*, 31W*, 32W*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a common emitter amplifier is working properly using voltage measurements.
- ▫ Demonstrate the ability to determine if a common collector amplifier is working properly using voltage measurements.
- ▫ Demonstrate the ability to determine if a common base amplifier is working properly using voltage measurements.

MOD 16 - POWER SUPPLIES

LESSON ID/TITLE CARDS/KITS

MOD 16 - POWER SUPPLIES (cont.)

5021-518-130 Introduction to Power Supplies and Diode Rectifiers ..... ---
- ▪ Describe the purpose of power supplies.
- ▪ Describe the sections of a typical power supply.
- ▪ Identify half-wave rectifiers.
- ▪ Identify full-wave rectifiers.
- ▪ Identify bridge rectifiers.

5021-518-160 Full- and Half-Wave Rectifier Operation 23
- ▪ Identify full- and half-wave rectifier circuits.
- ▪ Identify the purpose of individual rectifier components.
- ▪ Describe rectifier operating characteristics.
- ▫ Measure the input and output waveforms of half and full-wave rectifiers.
- ▫ Recognize normal operation of half and full-wave rectifiers.

5021-518-190 Bridge Rectifier Operation 24
- ▪ Identify bridge rectifier circuits.
- ▪ Identify the purpose of individual bridge rectifier components.
- ▪ Describe bridge rectifier operating characteristics.
- ▫ Measure the input and output waveforms of a bridge rectifier.
- ▫ Recognize normal operation of a bridge rectifier.

5021-518-220 Introduction to Voltage Regulators ..... ---
- ▪ Describe the purpose of series voltage regulators.
- ▪ Describe the operation of basic series voltage regulator circuits.
- ▪ Describe the purpose of parallel voltage regulators.
- ▪ Describe the operation of basic parallel voltage regulator circuits.

5021-518-250 Zener Diode Operation 22B
- ▪ Identify a zener schematic symbol.
- ▪ Identify the purpose of a zener diode.
- ▪ Describe the operation of zener diodes.
- ▪ Recognize the proper method of using a multimeter to verify zener diode operation.
- ▫ Predict the voltage drop of a reverse biased zener diode.
- ▫ Measure the voltage drop of a reverse biased zener diode.
- ▫ Recognize normal operation of a zener diode.

5021-518-280 Zener Diode Regulator Operation 23, 25
- ▪ Identify zener diode regulator circuits.
- ▪ Identify the purpose of individual zener diode regulator components.
- ▪ Describe zener diode regulator operating characteristics.
- ▫ Measure the input and output voltages of a zener diode regulator.
- ▫ Recognize normal operation of a zener diode regulator.

5021-518-310 Voltage Regulator Operation 23, 26
- ▪ Identify voltage regulator circuits.
- ▪ Identify the purpose of individual voltage regulator components.
- ▪ Describe voltage regulator operating characteristics.
- ▫ Measure the input and output voltages of a voltage regulator.
- ▫ Recognize normal operation of a voltage regulator.

5021-518-340 Voltage Regulator Troubleshooting Experiment 23, 25, 26
- ▪ Describe typical faults in voltage regulator circuits.
- ▪ Describe voltage regulator troubleshooting procedures.
- ▫ Recognize that a zener diode voltage regulator circuit is faulted.

LESSON ID/TITLE — CARDS/KITS

MOD 16 - POWER SUPPLIES (cont.)

5021-518-340 Voltage Regulator Troubleshooting Experiment (cont.)
- ▫ Observe the effects of a faulted component in a zener.
- ▫ Recognize that a variable voltage regulator circuit is faulted.
- ▫ Observe the effects of a faulted component in a variable voltage regulator circuit.

5021-518-400 IC Regulator Operation 74
- ▪ Describe the purpose of an IC regulator.
- ▪ Describe the operation of an IC regulator.
- ▫ Verify normal operation of an IC regulator.
- ▫ Define the advantages of an IC regulator.

5021-518-430 Voltage Doubler Operation 27
- ▪ Identify the purpose of a voltage doubler.
- ▪ Describe operation of half- and full-wave voltage doublers.
- ▪ Describe advantages and disadvantages of half- and full-wave voltage doublers.
- ▫ Identify normal operation of half- and full-wave voltage doublers.
- ▫ Observe the effect of loading a voltage doubler's output.
- ▫ Observe the effect of adding additional filter capacitance to a voltage doubler.

5021-518-920 Power Supplies Post-Test (Theory) . . . . . ---

5021-518-960 Power Supplies Post-Test (Performance) 22BW*, 23W*, 25W*, 26W*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a rectifier circuit is working properly using voltage measurements.
- ▫ Demonstrate the ability to determine if a voltage regulator circuit is working properly using voltage measurements.
- ▫ Demonstrate the ability to determine if a zener reference regulator circuit is working properly using voltage measurements.

MOD 17 - TRANSISTOR AMPLIFIERS

5021-520-130 Multistage Transistor Amplifiers . . . . . ---
- ▪ State the purpose of cascade amplifiers.
- ▪ Calculate total gain of a cascade amplifier.

5021-520-160 RC Coupled Transistor Amplifier Operation 33
- ▪ Describe the operating characteristics of an RC coupled transistor amplifier.
- ▪ Describe the effect of an input signal's amplitude and frequency in an RC coupled transistor amplifier.
- ▫ Measure the input and output waveforms of an RC coupled transistor amplifier.
- ▫ Recognize normal operation of an RC coupled transistor amplifier.
- ▫ Observe the effect of an input signal's amplitude and frequency in an RC coupled transistor amplifier.

5021-520-190 Push-Pull Amplifier Operation 34
- ▪ Identify push-pull amplifier circuits.
- ▪ Describe the operating characteristics of push-pull amplifiers.
- ▫ Measure the input and output waveforms of a common collector push-pull amplifier circuit.
- ▫ Recognize normal operation of a common collector push-pull amplifier circuit.

5021-520-220 Multistage Amplifier Troubleshooting Experiment 33, 34
- ▪ Describe the troubleshooting method of signal tracing.

LESSON ID/TITLE CARDS/KITS

MOD 17 - TRANSISTOR AMPLIFIERS (cont.)

5021-520-220 Multistage Amplifier Troubleshooting Experiment (cont.)
- ▪ Identify common faults in a multistage amplifier circuit.
- ▫ Recognize that a multistage amplifier circuit is faulted.
- ▫ Troubleshoot a faulted multistage amplifier circuit.

5021-520-280 Field Effect Transistor Amplifiers 49
- ▪ Recognize field effect transistor schematic symbols.
- ▪ Describe the construction of field effect transistors.
- ▪ Describe operating characteristics of field effect transistors.
- ▪ Identify basic FET amplifier configuration.
- ▪ Describe the operation of common source FET amplifiers.
- ▪ Describe the method to check for normal operation of common source FET amplifiers.
- ▫ Measure the input and output waveforms of a common source FET amplifier.
- ▫ Recognize normal operation of a common source FET amplifier.

5021-520-310 FET Amplifier Troubleshooting Experiment 49
- ▪ Describe typical faults in FET amplifier circuits.
- ▪ Describe FET amplifier troubleshooting procedures.
- ▫ Recognize that a FET amplifier circuit is faulted.
- ▫ Identify the faulted component in a FET amplifier circuit.

5021-520-370 Metal-Oxide Semiconductor Field Effect Transistor (MOSFET) . . . . . ---
- ▪ Recognize Metal-Oxide Semiconductor Field Effect Transistor (MOSFET) schematic symbols.
- ▪ Describe the construction of MOSFET devices.
- ▪ Describe the operation of Depletion-mode MOSFETs.
- ▪ Describe the operation of Enhancement-mode MOSFETs.
- ▪ Identify various MOSFET device applications.

5021-520-920 Transistor Amplifiers Post-Test (Theory) . . . . . ---

5021-520-960 Transistor Amplifiers Post-Test (Performance) 30AW*, 31W*, 32W*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a three-stage transistor amplifier circuit is working properly using voltage measurements.
- ▫ Demonstrate the ability to troubleshoot a three-stage transistor amplifier circuit using voltage measurements.

MOD 18 - TRANSISTOR OSCILLATORS

5021-522-130 Introduction to Sine Wave Oscillators . . . . . ---
- ▪ Describe the purpose of sine wave oscillators.
- ▪ Describe a basic sine wave oscillator circuit.
- ▪ Identify LC oscillators.
- ▪ Identify RC oscillators.
- ▪ Identify crystal oscillators.

5021-522-160 Hartley Oscillator Operation 35
- ▪ Identify the circuits in a Hartley oscillator.
- ▪ Describe operating characteristics of a Hartley oscillator.
- ▪ Identify the purpose of individual components in a Hartley oscillator.
- ▫ Measure the input and output waveforms of a Hartley oscillator.

LESSON ID/TITLE CARDS/KITS

MOD 18 - TRANSISTOR OSCILLATORS (cont.)

5021-522-160 Hartley Oscillator Operation (cont.)
- ▫ Recognize normal operation of a Hartley oscillator.

5021-522-190 Colpitts Oscillator Operation 36
- ▪ Identify the circuits in a Colpitts oscillator.
- ▪ Describe operating characteristics of a Colpitts oscillator.
- ▪ Identify the purpose of individual components in a Colpitts oscillator.
- ▫ Measure the input and output waveforms of a Colpitts oscillator.
- ▫ Recognize normal operation of a Colpitts oscillator.

5021-522-220 RC Phase Shift Oscillator Operation 37
- ▪ Identify RC phase shift oscillator circuits.
- ▪ Describe operating characteristics of RC phase shift oscillators.
- ▪ Identify the purpose of individual components in RC phase shift oscillators.
- ▫ Measure the input and output waveforms of an RC phase shift oscillator.
- ▫ Recognize normal operation of an RC phase shift oscillator.

5021-522-250 Crystal Controlled Oscillator Operation 50
- ▪ Describe characteristics of a quartz crystal.
- ▪ Identify and describe crystal oscillator circuits.
- ▪ Identify the purpose of individual components in a crystal oscillator.
- ▫ Measure the input and output waveforms of a crystal oscillator.
- ▫ Recognize normal operation of a crystal oscillator.

5021-522-280 Sine Wave Oscillator Troubleshooting Experiment I 35, 36
- ▪ Describe typical faults in Hartley and Colpitts oscillators.
- ▪ Describe Hartley and Colpitts oscillator troubleshooting procedures.
- ▫ Recognize that a Hartley oscillator is faulted.
- ▫ Identify the faulted component in a Hartley oscillator.
- ▫ Recognize that a Colpitts oscillator is faulted.
- ▫ Identify the faulted component in a Colpitts oscillator.

5021-522-310 Sine Wave Oscillator Troubleshooting Experiment II 37, 50
- ▪ Describe typical faults in RC phase shift and crystal oscillators.
- ▪ Describe RC phase shift and crystal oscillator troubleshooting procedures.
- ▫ Recognize that an RC phase shift oscillator is faulted.
- ▫ Identify the faulted component in an RC phase shift oscillator.
- ▫ Recognize that a crystal oscillator is faulted.
- ▫ Identify the faulted component in a crystal oscillator.

5021-522-340 Sawtooth Generator Operation 43A
- ▪ Describe the purpose of a sawtooth generator.
- ▪ Identify and describe input and output waveforms of a sawtooth generator.
- ▫ Measure the input and output waveforms of a sawtooth generator.
- ▫ Recognize normal operation of a sawtooth generator.

5021-522-370 Blocking Oscillator Operation 42
- ▪ Identify the purpose of blocking oscillators.
- ▪ Describe the operation of free-running and triggered blocking oscillators.
- ▫ Observe normal operation of free-running blocking oscillators.
- ▫ Observe normal operation of triggered blocking oscillators.

5021-522-400 Non-Sine Wave Oscillator Troubleshooting Experiment 42, 43A
- ▪ Describe typical faults in blocking oscillators and sawtooth generators.
- ▪ Describe blocking oscillator and sawtooth generator troubleshooting procedures.

LESSON ID/TITLE CARDS/KITS

MOD 18 - TRANSISTOR OSCILLATORS (cont.)

5021-522-400 Non-Sine Wave Oscillator Troubleshooting Experiment (cont.)
- ▫ Recognize that a blocking oscillator is faulted.
- ▫ Identify the faulted component in a blocking oscillator.
- ▫ Recognize that a sawtooth generator is faulted.
- ▫ Identify the faulted component in a sawtooth generator.

5021-522-920 Transistor Oscillators Post-Test (Theory) . . . . . ---

5021-522-960 Transistor Oscillators Post-Test (Performance) 42W*, 43AW*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a transistor oscillator circuit is working properly using voltage measurements.
- ▫ Demonstrate the ability to troubleshoot a transistor oscillator circuit using voltage measurements.

MOD 19 - TRANSISTOR PULSE AMPLIFIERS

5021-524-130 Introduction to Multivibrator Circuits . . . . . ---
- ▪ Describe the purpose of multivibrators.
- ▪ Describe a basic multivibrator circuit.
- ▪ Identify astable multivibrators.
- ▪ Identify monostable multivibrators.
- ▪ Identify bistable multivibrators.

5021-524-160 Astable Multivibrator Operation 44
- ▪ Identify astable multivibrator circuits.
- ▪ Identify the purpose of individual components in astable multivibrators.
- ▪ Describe the operation of astable multivibrators.
- ▫ Measure the input and output waveforms of an astable multivibrator.
- ▫ Recognize normal operation of an astable multivibrator.

5021-524-190 Monostable Multivibrator Operation 46
- ▪ Identify monostable multivibrator circuits.
- ▪ Identify the purpose of individual multivibrators.
- ▪ Describe the operating characteristics of monostable multivibrators.
- ▫ Measure the input and output waveforms of a monostable multivibrator.
- ▫ Recognize normal operation of a monostable multivibrator.

5021-524-220 Bistable Multivibrator Operation 45
- ▪ Identify bistable multivibrator circuits.
- ▪ Identify the purpose of individual multivibrators.
- ▪ Describe the operating characteristics of bistable multivibrators.
- ▫ Measure the input and output waveforms of a bistable multivibrator.
- ▫ Recognize normal operation of a bistable multivibrator.

5021-524-250 Multivibrator Troubleshooting Experiment 44, 46, 45
- ▪ Describe typical faults in astable, monostable, and bistable multivibrators.
- ▪ Describe multivibrator troubleshooting procedures.
- ▫ Recognize that an astable multivibrator is faulted.
- ▫ Identify the faulted component in an astable multivibrator.
- ▫ Recognize that a monostable multivibrator is faulted.
- ▫ Identify the faulted component in a monostable multivibrator.

LESSON ID/TITLE CARDS/KITS

MOD 19 - TRANSISTOR PULSE AMPLIFIERS (cont.)

5021-524-250 Multivibrator Troubleshooting Experiment (cont.)
- ▫ Recognize that a bistable multivibrator is faulted.
- ▫ Identify the faulted component in a bistable multivibrator.

5021-524-310 Schmitt Trigger Operation 47N
- ▪ Describe the purpose of a Schmitt trigger.
- ▪ Identify and describe Schmitt trigger circuits.
- ▫ Measure the input and output waveforms of a Schmitt trigger.
- ▫ Recognize normal operation of a Schmitt trigger with various inputs.

5021-524-340 Schmitt Trigger Troubleshooting Experiment 47N
- ▪ Describe typical faults in Schmitt trigger circuits.
- ▪ Describe Schmitt trigger troubleshooting procedures.
- ▫ Recognize that a Schmitt trigger is faulted.
- ▫ Identify the faulted component in a Schmitt trigger.

5021-524-920 Transistor Pulse Circuits Post-Test (Theory) . . . . . ---

5021-524-960 Transistor Pulse Circuits Post-Test (Performance) 44W*, 45W*, 46W*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a transistor pulse circuit is working properly using voltage measurements.
- ▫ Demonstrate the ability to troubleshoot a transistor pulse circuit using voltage measurements.

MOD 20 - TRIGGER DEVICE CIRCUITS

5021-526-130 Introduction to Trigger Devices . . . . . ---
- ▪ Describe the purpose of unijunction transistors.
- ▪ Identify unijunction transistor schematic symbols.
- ▪ Describe the operating characteristics of unijunction transistors.
- ▪ Describe the purpose of silicon control rectifiers.
- ▪ Identify silicon rectifier schematic symbols.
- ▪ Describe the operating characteristics of silicon control rectifiers.

5021-526-160 Unijunction Transistor Oscillator Operation 51
- ▪ Describe the purpose of UJT oscillators.
- ▪ Recognize UJT oscillator circuits.
- ▪ Describe the operation of UJT oscillators.
- ▫ Recognize normal operation of a UJT oscillator circuit.
- ▫ Measure waveforms in a UJT oscillator.

5021-526-190 SCR Trigger Circuit Operation 52A
- ▪ Describe the purpose of SCR trigger circuits.
- ▪ Recognize SCR trigger circuits.
- ▪ Describe the operation of an SCR trigger circuit.
- ▫ Measure the gate and anode current in an operating SCR trigger circuit.
- ▫ Recognize normal operation of an SCR trigger circuit.

5021-526-220 SCR Power Control Operation 52B
- ▪ Describe the purpose of SCR power control circuits.
- ▪ Describe the operation of an SCR power control circuit.
- ▫ Recognize normal operation of an SCR power control circuit.

LESSON ID/TITLE CARDS/KITS

MOD 20 - TRIGGER DEVICE CIRCUITS (cont.)

5021-526-220 SCR Power Control Operation (cont.)
- ▫ Measure the waveforms in an operating SCR power control circuit.

5021-526-250 SCR Trigger Circuit Troubleshooting Experiment 52A, 52B
- ▪ Describe typical faults in SCR trigger and power control circuits.
- ▪ Describe SCR trigger and power control circuit troubleshooting procedures.
- ▫ Recognize when an SCR trigger circuit is faulted.
- ▫ Identify the faulted component in an SCR trigger circuit.
- ▫ Recognize when an SCR power control circuit is faulted.
- ▫ Identify the faulted component in an SCR power control circuit.

5021-526-310 Triacs, Diacs, and Four-Layer Diodes 88
- ▪ Describe the relationship between triacs and SCRs.
- ▪ Recognize triac circuit operation based on input conditions.
- ▪ Describe the relationship between diacs and four-layer diodes.
- ▪ Explain the beneficial use of a diac with a triac.
- ▫ Observe the effect of AC voltages with basic triac operation.
- ▫ Observe the effect of DC voltages with basic triac operation.
- ▫ Understand the effects of triggering a triac with AC waveforms.

5021-526-340 Programmable Unijunction Transistors . . . . . ---
- ▪ Recognize the PUT schematic symbol.
- ▪ Describe the construction of PUT devices.
- ▪ Describe the operation of PUT devices.
- ▪ Identify PUT device applications.

5021-526-920 Trigger Device Circuits Post-Test (Theory) . . . . . ---

5021-526-960 Trigger Device Circuits Post-Test (Performance) 52AW*, 52BW*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a trigger device power control circuit is working properly using voltage measurements.
- ▫ Demonstrate the ability to determine if a DC control circuit is working properly using voltage measurements.

MOD 21 - OPERATIONAL AMPLIFIERS

5021-528-130 Introduction to Operational Amplifiers . . . . . ---
- ▪ Describe operational amplifiers.
- ▪ Describe the types of circuits used in an operational amplifier.
- ▪ Describe the basic construction of IC operational amplifiers.
- ▪ Recognize differential amplifier circuits.
- ▪ Describe basic operating characteristics of differential amplifiers.

5041-118-130 Operational Amplifiers . . . . . ---
- ▪ Describe the operational amplifier and how it is used.
- ▪ Describe the schematic symbol and packaging of operational amplifiers.
- ▪ Describe the basic operation of operational amplifiers.
- ▪ Describe operational amplifier characteristics.
- ▪ Describe linear operational amplifiers.
- ▪ Describe arithmetic operational amplifiers.
- ▪ Describe wave shaping operational amplifiers.

LESSON ID/TITLE CARDS/KITS

MOD 21 - OPERATIONAL AMPLIFIERS (cont.)

5041-118-160 Operational Amplifier Experiment 161, 162, 163
- ▫ Observe the operation of inverting and non-inverting amplifiers.
- ▫ Measure signals in inverting and non-inverting amplifiers.
- ▫ Locate faults in inverting and non-inverting amplifiers.
- ▫ Observe the operation of summing and difference amplifiers.
- ▫ Measure signals in summing and difference amplifiers.
- ▫ Locate faults in summing and difference amplifiers.
- ▫ Observe the operation of integrator and differentiator amplifiers.
- ▫ Measure signals in integrator and differentiator amplifiers.
- ▫ Locate faults in integrator and differentiator amplifiers.

5021-528-920 Operational Amplifiers Post-Test (Theory) . . . . . ---

5021-528-960 Operational Amplifiers Post-Test (Performance) 54w*
- ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
- ▫ Demonstrate the ability to determine if a summing/difference operational amplifier is working properly using voltage measurements.
- ▫ Demonstrate the ability to determine if an inverting/non-inverting operational amplifier is working properly using voltage measurements.

MOD 22 - INTRODUCTION TO RF CIRCUITS

5021-530-130 Introduction to AM Receivers . . . . . ---
- ▪ List the primary functions of an AM receiver.
- ▪ Describe AM receiver primary functions.
- ▪ Identify the basic functional blocks of an AM receiver.

5021-530-170 AM Receiver Operation . . . . . ---
- ▪ Recognize AM receiver circuits.
- ▪ Describe the operating characteristics of AM receiver circuits.

5021-530-200 AM Receiver Troubleshooting . . . . . ---
- ▪ Describe the four-step method for troubleshooting electronic equipment.
- ▪ Describe how the four-step method is applied to AM receivers.

5021-530-920 Introduction to RF Electronics Post-Test (Theory) . . . . . ---

MOD 23 - SWITCHING POWER DEVICES

5021-612-130 Switching Power Devices . . . . . ---
- ▪ Describe solid-state switching devices.
- ▪ Describe the advantages of using a solid-state switching device.
- ▪ Explain uses for solid-state switching devices.

5021-612-160 Bipolar Junction Transistor (BJT) 551
- ▪ Recognize BJT schematic symbol.
- ▪ Describe the construction of BJT devices.
- ▪ Describe the BJT as a switching device.
- ▫ Test and confirm normal operation of a switching BJT.
- ▫ Perform measurements on the switching BJT circuitry.
- ▫ Confirm the normal operation of a switching BJT circuit.
- ▫ Troubleshoot switching BJT circuitry.

LESSON ID/TITLE CARDS/KITS

MOD 23 - SWITCHING POWER DEVICES (cont.)

5021-612-190 Metal-Oxide Semiconductor Field Effect Transistor (MOSFET) 551
- ▪ Recognize power MOSFET schematic symbols.
- ▪ Describe the construction of power MOSFET devices.
- ▪ Describe the power MOSFET as a switching device.
- ▫ Test and confirm normal operation of a switching MOSFET.
- ▫ Perform measurements on a metal-oxide field effect transistor.
- ▫ Confirm the normal operation of a switching MOSFET circuit.
- ▫ Troubleshoot switching MOSFET circuitry.

5021-612-220 Insulated-Gate Bipolar Transistor (IGBT) 551
- ▪ Recognize IGBT schematic symbols.
- ▪ Describe the construction of IGBT devices.
- ▪ Describe the IGBT as a switching device.
- ▫ Test and confirm normal operation of a switching IGBT.
- ▫ Perform measurements on the switching IGBT circuitry.
- ▫ Confirm the normal operation of a switching IGBT circuit.
- ▫ Troubleshoot switching IGBT circuitry.

5021-612-920 Switch Power Devices Post-Test (Theory) . . . . . ---

MOD 24 - INTRODUCTION TO DIGITAL CIRCUITS

5022-712-130 Introduction to Digital Electronics 2404
- ▪ Identify developments of digital electronics.
- ▪ Describe the growth of computing equipment.
- ▪ Identify uses of digital electronics.
- ▪ Describe input and output conditions for digital circuits.
- ▪ Identify the AND, OR, and NOT functions.
- ▪ Recognize the digital truth table.
- ▪ Recognize the AND, OR, and NOT Boolean equations.
- ▫ Observe the operation of various digital gates.
- ▫ Read a truth table.
- ▫ Recognize HIGH and LOW outputs.

5022-712-160 Digital Electronics Hardware . . . . . ---
- ▪ Define integrated circuit.
- ▪ Identify three forms of integrated circuit packaging.
- ▪ Identify markings associated with integrated circuits.
- ▪ Identify integrated circuit functions.
- ▪ Describe the purpose of a data book.

5022-712-190 Digital Test Equipment 2402
- ▪ Describe the purpose of a clock generator circuit.
- ▪ Identify the signals produced by the clock generator.
- ▪ Identify the basic components of a clock generator.
- ▪ Describe the purpose of a logic probe.
- ▪ Describe basic operation of a logic probe.
- ▫ Operate a simple clock generator circuit.
- ▫ Operate a logic probe.

5022-712-210 555 Timer 153
- ▪ Describe the purpose of the 555 timer.

LESSON ID/TITLE CARDS/KITS

MOD 24 - INTRODUCTION TO DIGITAL CIRCUITS (cont.)

5022-712-210 555 Timer (cont.)
- ▪ Describe the internal operation of the 555 timer.
- ▪ Describe the operation of a 555 timer used as an astable multivibrator.
- ▪ Describe the operation of a 555 timer used as a monostable multivibrator.
- ▫ Observe the operation of a 555 timer circuit.
- ▫ Operate a 555 timer in astable and monostable multivibrator configurations.

5022-712-220 Introduction to Integrated Circuits . . . . . ---
- ▪ Identify the different IC construction classifications.
- ▪ Identify integration classifications.
- ▪ Explain the construction of a basic IC.
- ▪ Understand the various IC packaging arrays.
- ▪ Identify basic IC packaging materials.
- ▪ Identify various integrated components.
- ▪ Interpret basic IC numbers.
- ▪ Locate information on an IC using an IC data book.

5022-712-920 Introduction to Digital Circuits Post-Test (Theory) . . . . . ---

MOD 25 - DIGITAL LOGIC FUNCTIONS

5022-714-130 Buffers and Inverters 2402
- ▪ Describe the purpose of a buffer.
- ▪ Describe the purpose of an inverter.
- ▪ Describe input threshold voltages.
- ▪ Describe output threshold voltages.
- ▫ Measure threshold voltages.

5022-714-160 AND Gates 2404
- ▪ Identify AND operation.
- ▪ Identify AND logic symbols.
- ▪ Identify AND logic schematic representation.
- ▪ Construct an AND gate truth table.
- ▪ Identify input and output waveforms.
- ▫ Measure input and output waveforms.

5022-714-190 OR Gates 2404
- ▪ Identify OR operation and logic symbols.
- ▪ Construct an OR gate truth table.
- ▪ Identify input and output waveforms.
- ▫ Measure input and output waveforms.

5022-714-220 NAND Gates 2404
- ▪ Identify NAND operation.
- ▪ Identify NAND logic symbols.
- ▪ Identify NAND logic schematic representation.
- ▪ Construct a NAND gate truth table.
- ▪ Identify input and output waveforms.
- ▫ Measure input and output waveforms.

5022-714-250 NOR Gates 2404
- ▪ Identify NOR operation.
- ▪ Identify NOR logic symbols.

LESSON ID/TITLE CARDS/KITS

MOD 25 - DIGITAL LOGIC FUNCTIONS (cont.)

5022-714-250 NOR Gates (cont.)
- ▪ Identify NOR logic schematic representation.
- ▪ Construct a NOR gate truth table.
- ▪ Identify input and output waveforms.
- ▫ Measure input and output waveforms.

5022-714-280 XOR and XNOR Gates 2406
- ▪ Identify XOR and XNOR operation.
- ▪ Identify XOR and XNOR logic symbols.
- ▪ Identify XOR and XNOR logic schematic representation.
- ▪ Construct truth tables for XOR and XNOR gates.
- ▪ Identify input and output waveforms of XOR and XNOR gates.
- ▫ Measure the input and output waveforms of an XOR gate and an XNOR gate.

5022-714-310 Digital and Analog Switches 2424
- ▪ Compare the digital and analog switch to other switching methods.
- ▪ Discuss the theory of digital and analog switch operation.
- ▪ Identify the operation parameters of the digital and analog switch.
- ▪ Analyze the digital and analog switch in SPST, SPDT, DPST, and DPDT configurations.
- ▪ Review practical applications for the digital and analog switch.
- ▫ Reinforce the operation of digital and analog switches through experimentation.
- ▫ Probe and confirm all test points in the digital and analog switch circuit.
- ▫ Troubleshoot the digital and analog switch circuit.

5022-714-920 Digital Logic Circuits Post-Test (Theory) . . . . . ---

MOD 26 - COMBINATIONAL LOGIC CIRCUITS

5022-716-130 Introduction to Combinational Circuits . . . . . ---
- ▪ Define combinational logic.
- ▪ Describe the uses of combinational logic.
- ▪ Trace inputs through a combinational logic circuit.
- ▪ Describe the universal property of the NAND gate.
- ▪ Describe the universal property of the NOR gate.

5022-716-160 Logic Families . . . . . ---
- ▪ Describe TTL logic.
- ▪ Identify supply voltage.
- ▪ Define fan-in and fan-out.
- ▪ Define propagation delay.
- ▪ Describe CMOS logic.
- ▪ Describe ECL logic.
- ▪ Describe IIL logic.

5022-716-190 Number Systems . . . . . ---
- ▪ Recognize the decimal number system.
- ▪ Recognize the binary number system.
- ▪ Recognize the octal number system.
- ▪ Recognize the hexadecimal number system.
- ▪ Convert decimal numbers to binary numbers.
- ▪ Convert binary numbers to decimal numbers.
- ▪ Convert octal numbers to binary numbers.

LESSON ID/TITLE CARDS/KITS

MOD 26 - COMBINATIONAL LOGIC CIRCUITS (cont.)

5022-716-190 Number Systems (cont.)
- ▪ Convert hexadecimal numbers to binary numbers.
- ▪ Add binary numbers.
- ▪ Subtract binary numbers.
- ▪ Multiply binary numbers.
- ▪ Divide binary numbers.

5022-716-220 Base 10 to Binary Conversion 2416
- ▪ Identify the purpose of a decimal encoder.
- ▪ Identify a decimal-to-binary encoder circuit.
- ▫ Predict the outputs of a decimal encoder.
- ▫ Probe the outputs of a decimal encoder.
- ▫ Recognize normal operation of a decimal encoder.

5022-716-250 Binary to Decimal Conversion 2418, 2420
- ▪ Identify the purpose of a binary decoder.
- ▪ Describe a seven segment display.
- ▪ Describe a binary to LED decimal decoder circuit.
- ▪ Describe a binary to decimal seven segment decoder circuit.
- ▫ Predict the inputs and outputs of a BCD to discrete decimal decoder.
- ▫ Examine the inputs and outputs of a BCD to discrete decimal decoder.
- ▫ Recognize normal operation of a BCD to discrete decimal decoder.
- ▫ Predict the inputs and outputs of a BCD to 7 segment decoder.
- ▫ Examine the inputs and outputs of a BCD to 7 segment decoder.
- ▫ Recognize normal operation of a BCD to 7 segment decoder.

5022-716-920 Combinational Logic Circuits Post-Test (Theory) . . . . . ---

MOD 27 - FLIP-FLOP CIRCUITS

5022-718-130 Introduction to Latches and Flip-Flops . . . . . ---
- ▪ Identify the difference between a sequential circuit and a combinational circuit.
- ▪ Recognize SET and RESET conditions.
- ▪ Understand basic flip-flop operation.
- ▪ Describe the operation of RS and ~R~S latches.
- ▪ Identify the RS and ~R~S latch truth tables.
- ▪ Describe the race condition in the RS and ~R~S latches.

5022-718-160 RS Flip-Flops 2408
- ▪ Identify the purpose of an RS flip-flop.
- ▪ Describe an RS flip-flop circuit.
- ▫ Predict the outputs of the RS and ~R~S flip-flop.
- ▫ Verify the inputs and outputs of the RS and ~R~S flip-flops.
- ▫ Understand the basic principles of the RS and ~R~S flip-flops.

5022-718-220 D-Type Flip-Flops 2410
- ▪ Identify the purpose of a D-type flip-flop.
- ▪ Describe a D-type flip-flop circuit.
- ▫ Predict inputs and outputs of a D-type flip-flop.
- ▫ Probe the inputs and outputs of a D-type flip-flop.
- ▫ Recognize outputs of a D-type flip-flop.

LESSON ID/TITLE CARDS/KITS

MOD 27 - FLIP-FLOP CIRCUITS (cont.)

5022-718-250 JK Flip-Flops 2410
- ▪ Describe the JK flip-flop symbol and truth table.
- ▪ Explain the operation of a JK flip-flop.
- ▪ Develop a timing diagram for a JK flip-flop.
- ▫ Predict the inputs and outputs of a JK flip-flop.
- ▫ Probe inputs and outputs of a JK flip-flop.
- ▫ Recognize outputs of a JK flip-flop.

5022-718-920 Flip-Flop Circuits Post-Test (Theory) . . . . . ---

MOD 28 - REGISTER MEMORY CIRCUITS

5022-720-130 Introduction to Registers and Memory . . . . . ---
- ▪ Describe the terms data, bit, and byte.
- ▪ Describe serial data transfer.
- ▪ Describe parallel data transfer.
- ▪ Identify the purpose of a register.
- ▪ Describe storage and shift registers.

5022-720-160 Serial Shift Registers 2422
- ▪ Identify the purpose of a 4-bit shift register.
- ▪ Recognize 4-bit shift register circuits.
- ▫ Predict the output of a serial shift register.
- ▫ Examine inputs and outputs of a serial shift register.
- ▫ Recognize normal operation of a serial shift register.

5022-720-190 Parallel Shift Registers 2422
- ▪ Identify the purpose of a 4-bit shift register.
- ▪ Describe shift right and shift left.
- ▪ Recognize 4-bit shift register circuits.
- ▫ Predict the output of a parallel shift register.
- ▫ Probe the inputs and outputs of a parallel shift register.
- ▫ Recognize normal operation of a parallel shift register.

5022-720-220 64-Bit Memory Circuit 2428
- ▪ Identify the purpose of a 64-bit memory circuit.
- ▪ Define terms as they apply to memory circuits: word, address, read, write, RAM, ROM, volatile, and nonvolatile.
- ▪ Recognize 64-bit memory circuits.
- ▫ Reinforce the understanding of memory operation through experimentation.
- ▫ Probe all test points in the memory circuit.
- ▫ Troubleshoot the memory circuit.

5022-720-920 Register Memory Circuits Post-Test (Theory) . . . . . ---

MOD 29 - ARITHMETIC COUNTING CIRCUITS

5022-722-130 Introduction to Arithmetic Counting Circuits . . . . . ---
- ▪ Identify the purpose of a counter.
- ▪ Describe modulus.
- ▪ Recognize basic synchronous and asynchronous counter circuits.
- ▪ Describe how a counter divides and is used as a timing circuit.
- ▪ Identify the purpose of an adder.

LESSON ID/TITLE CARDS/KITS

MOD 29 - ARITHMETIC COUNTING CIRCUITS (cont.)

5022-722-130 Introduction to Arithmetic Counting Circuits (cont.)
- ▪ Describe how adders are used in addition, multiplication, subtraction, and division.

5022-722-160 Ripple Counter 2414
- ▪ Identify the purpose of a ripple counter.
- ▪ Describe a basic ripple counter circuit.
- ▪ Recognize ripple counter circuits with different moduli.
- ▫ Predict the inputs and outputs of ripple and decade counters.
- ▫ Probe the inputs and outputs of ripple and decade counters.
- ▫ Recognize normal operation of ripple and decade counters.

5022-722-190 Up Counter 2412
- ▪ Identify the purpose of an up counter.
- ▪ Describe a basic up counter circuit.
- ▪ Recognize free run and single step circuits of an up counter.
- ▫ Understand the operation of the up counter.
- ▫ Predict the inputs and outputs of the up counter.

5022-722-220 Down Counter 2412
- ▪ Identify the purpose of a down counter.
- ▪ Describe a basic down counter circuit.
- ▪ Recognize free run and single step circuits of a down counter.
- ▫ Predict the inputs and outputs of a down counter.
- ▫ Recognize normal operation of a down counter.

5022-722-250 4-Bit Adder 2426
- ▪ Identify the purpose of a 4-bit adder.
- ▪ Describe adder circuits.
- ▪ Recognize serial and parallel full adder circuits.
- ▫ Recognize the normal operation of the 4-bit adder circuit.
- ▫ Predict the output of the 4-bit adder.
- ▫ Confirm the output of the 4-bit adder circuit.

5022-722-280 4-Bit Subtractor 2426
- ▪ Identify the purpose of a 4-bit subtractor.
- ▪ Describe two's complement.
- ▪ Recognize serial and parallel full subtractor circuits.
- ▫ Predict the outputs of a 4-bit subtractor circuit.
- ▫ Probe the outputs of a 4-bit subtractor circuit.
- ▫ Recognize normal operation of a 4-bit subtractor circuit.

5022-722-920 Arithmetic Counting Circuits Post-Test (Theory) . . . . . ---

MOD 30 - CONVERSION AND DATA CIRCUITS

5022-724-130 Introduction to Conversion and Data Circuits . . . . . ---
- ▪ Identify the purpose of conversion circuits.
- ▪ Recognize basic A/D and D/A circuits.
- ▪ Identify the purpose of data circuits.
- ▪ Recognize basic data selector and data distributor circuits.

5022-724-160 D/A Conversion 2430, 2432
- ▪ Identify the D/A conversion process.
- ▫ Understand tri-state device functions.

LESSON ID/TITLE CARDS/KITS

MOD 30 - CONVERSION AND DATA CIRCUITS (cont.)

5022-724-160 D/A Conversion (cont.)
- ▫ Analyze an 8-bit D/A circuit.
- ▫ Observe operation of an 8-bit D/A circuit.
- ▫ Observe operation of an A/D - D/A circuit.
- ▫ Troubleshoot an A/D - D/A circuit.

5022-724-190 A/D Conversion 2432
- ▪ Identify the A/D conversion process.
- ▫ Analyze 8-bit A/D circuitry.
- ▫ Troubleshoot the A/D circuit.

5021-726-130 Troubleshooting Digital Systems . . . . . ---
- ▪ Understand a basic troubleshooting method for ICs.
- ▪ Identify common internal digital IC faults and their symptoms.
- ▪ Identify common external digital IC faults and their symptoms.
- ▪ Understand basic procedures used to troubleshoot digital systems.

5022-724-920 Conversion and Data Circuits Post-Test (Theory) . . . . . ---

MOD 31 - MICROCONTROLLER (8051)

5082-212-130 Introduction to Microprocessors . . . . . ---
- ▪ Describe a brief development of microprocessors.
- ▪ Identify the major parts of a microprocessor system.
- ▪ Define common terms associated with microprocessors.

5082-212-160 Basic Microprocessor Operations . . . . . ---
- ▪ Identify parts of a microprocessor and describe microprocessor operation.
- ▪ Define and describe internal registers and counters.
- ▪ Understand the physical characteristics of RAM and ROM.
- ▪ Describe the difference between RAM and ROM.
- ▪ Understand the configuration caches, conventional, extended, upper, high, and expanded memory.
- ▪ Know the purpose of caches, conventional, extended, upper, high, and expanded memory.
- ▪ Explain the evolution of caches, conventional, extended, upper, high, and expanded memory.

5082-212-190 Microprocessor Number Systems . . . . . ---
- ▪ Identify different mathematical numbering systems.
- ▪ Describe and perform number system conversions.
- ▪ Describe and perform binary addition and subtraction.
- ▪ Describe and perform multiplication and division.

5082-222-130 8051 Microcontroller Circuit 405, 406, 407
- ▪ Describe the internal structure of the 8051 microcontroller.
- ▪ Describe the timed operations of the 8051 microcontroller.
- ▫ Observe signals from the 8051 microcontroller circuit.
- ▫ Enter a simple program to observe system operation.

5082-222-160 Operation of the 8051 Microcontroller 405, 406, 407
- ▪ Describe external timing and control connections to the 8051 microcontroller.
- ▪ Describe the memory connections to the 8051 microcontroller.
- ▫ Observe the various signals generated by the 8051 microcontroller.
- ▫ Observe the operation of external memory.

LESSON ID/TITLE — CARDS/KITS

MOD 31 - MICROCONTROLLER (8051) (cont.)

5082-222-190 Interfacing with the 8051 Microcontroller 405, 406, 407
- ▪ Describe the connection of input/output devices attached to the 8051.
- ▪ Understand the different types of input/output devices connected to a microcontroller.
- ▫ Observe signals of the keyboard circuitry in the microcontroller system.

5082-222-220 Troubleshooting the 8051 Microcontroller 405, 406, 407
- ▪ Describe the techniques required to troubleshoot a defective microcontroller system.
- ▪ Describe preventive maintenance.
- ▪ Describe the basic tool used to troubleshoot a microcontroller system.
- ▫ Perform successful troubleshooting with the 8051 microcontroller trainer.
- ▫ Understand basic fault types in a microcontroller system.

5082-222-920 8051 Microcontroller Post-Test (Theory) . . . . . ---

MOD 32 - MICROPROCESSOR (8085/8086)

5082-212-130 Introduction to Microprocessors . . . . . ---
- ▪ Describe a brief development of microprocessors.
- ▪ Identify the major parts of a microprocessor system.
- ▪ Define common terms associated with microprocessors.

5082-212-160 Basic Microprocessor Operations . . . . . ---
- ▪ Identify parts of a microprocessor and describe microprocessor operation.
- ▪ Define and describe internal registers and counters.
- ▪ Understand the physical characteristics of RAM and ROM.
- ▪ Describe the difference between RAM and ROM.
- ▪ Understand the configuration caches, conventional, extended, upper, high, and expanded memory.
- ▪ Know the purpose of caches, conventional, extended, upper, high, and expanded memory.
- ▪ Explain the evolution of caches, conventional, extended, upper, high, and expanded memory.

5082-212-190 Microprocessor Number Systems . . . . . ---
- ▪ Identify different mathematical numbering systems.
- ▪ Describe and perform number system conversions.
- ▪ Describe and perform binary addition and subtraction.
- ▪ Describe and perform multiplication and division.

5082-224-170 Operation of the 8085 Microprocessor . . . . . ---
- ▪ Describe timing and control connections to the 8085 microprocessor.
- ▪ Describe the memory connections to the 8085 microprocessor.

5082-224-200 Interfacing with the 8085 Microprocessor . . . . . ---
- ▪ Describe the connection of input/output devices attached to the 8085.
- ▪ Understand the different types of input/output devices connected to a microprocessor.

5082-224-230 Troubleshooting the 8085 Microprocessor . . . . . ---
- ▪ Describe the techniques required to troubleshoot a defective microprocessor system.
- ▪ Describe preventive maintenance.
- ▪ Describe the basic tools used to troubleshoot a microprocessor system.

5082-226-130 8086 Microprocessor Circuit 401, 404, 410, 411
- ▪ Describe the internal structure of the 8086 microprocessor.
- ▪ Understand the various internal components.
- ▪ Understand the external connections to the 8086.

LESSON ID/TITLE CARDS/KITS

MOD 32 - MICROPROCESSOR (8085/8086) (cont.)

5082-226-130 8086 Microprocessor Circuit (cont.)
- ▫ Demonstrate the ability to examine signal conditions of the 8086.
- ▫ Demonstrate the ability to enter a program into the 8086.

5082-226-160 Operation of the 8086 Microprocessor 401, 404, 410, 411
- ▪ Describe external timing and control connections to the 8086 microprocessor.
- ▪ Describe the memory connections to the 8086 microprocessor.
- ▫ Observe the various signals generated by the 8086 microprocessor.
- ▫ Observe memory interface signals during actual microprocessor operation.

5082-226-190 Interfacing with the 8086 Microprocessor 401, 404, 410, 411
- ▪ Describe the connection of input/output devices attached to the 8086.
- ▪ Understand the different types of input/output devices connected to a microprocessor.
- ▫ Observe the operation of an input/output device as it is used in a microprocessor system.

5082-226-220 Troubleshooting the 8086 Microprocessor 401, 404, 410, 411
- ▪ Describe the techniques required to troubleshoot a defective microprocessor system.
- ▪ Describe preventive maintenance.
- ▪ Describe the basic tools used to troubleshoot a microprocessor system.
- ▫ Perform successful troubleshooting with the 8086 microprocessor trainer.
- ▫ Understand basic fault types in a microprocessor system.

5082-226-250 8086 Data Transfer Instructions 401, 404, 410, 411
- ▪ Describe immediate data transfers.
- ▪ Describe direct data transfers.
- ▪ Describe indirect data transfers.
- ▫ Perform immediate data transfers in an 8086 microprocessor.
- ▫ Perform direct data transfers in an 8086 microprocessor.
- ▫ Perform indirect data transfers in an 8086 microprocessor.

5082-226-280 8086 Addition and Subtraction 401, 404, 410, 411
- ▪ Describe computer addition.
- ▪ Describe computer subtraction.
- ▫ Perform computer addition.
- ▫ Perform computer subtraction.

5082-226-310 8086 Logic Instructions 401, 404, 410, 411
- ▪ Describe logic instructions.
- ▫ Perform operations using logic instructions.

5082-226-340 8086 Jump Instructions 401, 404, 410, 411
- ▪ Describe jump instructions.
- ▫ Perform jump instructions.

5082-226-920 8086 Microprocessor Post-Test (Theory) . . . . . ---

MOD 33 - MICROPROCESSOR (68000)

5082-212-130 Introduction to Microprocessors . . . . . ---
- ▪ Describe a brief development of microprocessors.
- ▪ Identify the major parts of a microprocessor system.
- ▪ Define common terms associated with microprocessors.

5082-212-160 Basic Microprocessor Operations . . . . . ---
- ▪ Identify parts of a microprocessor and describe microprocessor operation.
- ▪ Define and describe internal registers and counters.

LESSON ID/TITLE CARDS/KITS

MOD 33 - MICROPROCESSOR (68000) (cont.)

5082-212-160 Basic Microprocessor Operations (cont.)
- ▪ Understand the physical characteristics of RAM and ROM.
- ▪ Describe the difference between RAM and ROM.
- ▪ Understand the configuration caches, conventional, extended, upper, high, and expanded memory.
- ▪ Know the purpose of caches, conventional, extended, upper, high, and expanded memory.
- ▪ Explain the evolution of caches, conventional, extended, upper, high, and expanded memory.

5082-212-190 Microprocessor Number Systems . . . . . ---
- ▪ Identify different mathematical numbering systems.
- ▪ Describe and perform number system conversions.
- ▪ Describe and perform binary addition and subtraction.
- ▪ Describe and perform multiplication and division.

5082-228-130 Introduction to 68000 Microprocessors . . . . . ---
- ▪ Identify the major sections of a microprocessor system.
- ▪ Define the buses used by the 68000 for addressing, data, and control.
- ▪ Define the modes of operation for the 68000.
- ▪ Understand the use and manipulation of binary, hexadecimal, and decimal numbering systems.
- ▪ Understand ASCII and BCD data encoding.

5082-228-160 The 68000 Microprocessor 401, 403, 404, 468
- ▪ Define the different package styles of the 68000 microprocessor.
- ▪ Understand label identification on the 68000 microprocessor.
- ▪ Identify the address, data and control buses of the 68000 microprocessor.
- ▪ Identify the operation of the clock and reset circuits of the 68000 microprocessor.
- ▪ Identify the operation of the microprocessor interrupts.
- ▫ Observe the operation of the 68000 buses.

5082-228-190 Registers and Memory 401, 403, 404, 468
- ▪ Define the purpose and usage of the internal registers.
- ▪ Understand the operation of the user and supervisor stacks.
- ▪ Define the types of external memory.
- ▪ Explain the connections and control of memory in the 68000 microprocessor.
- ▫ Observe the contents of registers in the 68000.
- ▫ Observe the contents of external memory to the 68000.

5082-228-220 I/O Circuits 401, 403, 404, 468
- ▪ Understand the purpose and usage of I/O circuits.
- ▪ Understand the operation of the 68000 keyboard.
- ▪ Understand the operation of the 68000 LCD.
- ▪ Understand the operation of the serial and parallel ports.
- ▫ Observe data communications through the parallel port.

5082-228-250 Operation of the 68000 . . . . . 401, 403, 404, 468
- ▪ Explain the vector addressing of the 68000 microprocessor.
- ▪ Understand the different states of microprocessor operation.
- ▪ Describe the different types of exceptions recognized by the 68000 microprocessor.
- ▫ Observe the occurrence of exceptions in manually entered code.
- ▫ Explain and observe the results of the exceptions caused by the manually entered code.

LESSON ID/TITLE — CARDS/KITS

MOD 33 - MICROPROCESSOR (68000) (cont.)

5082-228-280 Introduction to Programming 401, 403, 404, 468
- ▪ Explain the purpose and usage of programming in a microprocessor system.
- ▪ Understand the different types of programming and the type used by the Nida 68000 microprocessor trainer.
- ▪ Define the different groups of instructions and which instructions are in those groups.
- ▫ Observe and understand all of the instruction code of a simple program.
- ▫ Observe the effects of executing the simple program.

5082-228-310 Move and Branch Commands 401, 403, 404, 468
- ▪ Define, understand, and use the different types of move instructions.
- ▪ Define, understand, and use the different types of branch instructions.
- ▫ Demonstrate the usage of move and branch commands.

5082-228-340 Arithmetic and Logic Commands 401, 403, 404, 468
- ▪ Understand the different types and use of arithmetic instructions.
- ▪ Understand the different types and use of logic instructions.
- ▫ Demonstrate the use of both arithmetic and logic instructions.

5082-228-370 Test and Additional Commands 401, 403, 404, 468
- ▪ Understand the different types of test instructions.
- ▪ Understand the different uses of test instructions.
- ▪ Understand the different types of additional instructions.
- ▪ Understand the different uses of additional instructions.
- ▫ Demonstrate the use of a test instruction.
- ▫ Demonstrate the use of an additional instruction.

5082-228-400 Debugging and Compatibility 401, 403, 404, 468
- ▪ Understand debugging programs and tools.
- ▪ Identify other Motorola processors compatible with the 68000, and understand their characteristics.
- ▫ Demonstrate the ability to debug a small program.

5082-228-430 Troubleshooting the 68000 . . . . . 401, 403, 404, 468
- ▪ Define the techniques required to troubleshoot a defective microprocessor system.
- ▪ Describe preventive maintenance.
- ▪ Describe the basic tools used to troubleshoot microprocessor systems.
- ▫ Perform successful troubleshooting with the 68000 microprocessor trainer.

5082-228-920 68000 Microprocessor Post-Test (Theory) . . . . . ---

MOD 34 - FILTERS

5041-116-130 Introduction to Filters . . . . . ---
- ▪ Define an active and passive filter.
- ▪ Define inductive and capacitive reactance.
- ▪ Define a low-pass filter.
- ▪ Define a high-pass filter.
- ▪ Define a band pass filter.
- ▪ Define a band reject filter.

5041-116-160 High-Pass Filters 145
- ▪ Describe the operation of high-pass filters.
- ▪ Describe the types of high-pass filters.
- ▪ Calculate high-pass filter circuit values.

LESSON ID/TITLE CARDS/KITS

MOD 34 - FILTERS (cont.)

5041-116-160 High-Pass Filters (cont.)
- ▫ Observe the normal operation of a high-pass filter.
- ▫ Verify correct operation of a high-pass filter circuit.
- ▫ Determine if a high-pass filter circuit is faulted.
- ▫ Identify a faulted component in a high-pass filter circuit.

5041-116-190 Low-Pass Filters 146
- ▪ Describe the theory of operation of a low-pass filter.
- ▪ Identify low-pass filter circuits.
- ▪ Discuss the cutoff frequency of a low pass RC filter circuit.
- ▫ Verify proper low-pass filter operation.
- ▫ Determine the cutoff frequency of a low pass RC filter circuit.

5041-116-220 Bandpass Filters 147
- ▪ Describe the theory of operation of a band-pass filter.
- ▪ Discuss the upper and lower cutoff frequencies of a band-pass filter.
- ▪ Identify a band-pass filter circuit.
- ▫ Verify proper band-pass filter operation.
- ▫ Determine the bandwidth of a band-pass filter.

5041-116-250 Band-Reject Filters 148
- ▪ Discuss the theory of operation of a band-reject filter.
- ▪ Identify a typical band-reject filter circuit.
- ▫ Verify proper band-reject filter circuit operation.
- ▫ Determine the bandwidth of a typical band-reject filter.

5041-116-920 Filters Post-Test (Theory) . . . . . ---

MOD 35 - CIRCUIT CONSTRUCTION

5021-912-130 Circuit Construction 130X
- ▪ Describe soldering and breadboarding methods of circuit construction.
- ▪ Describe the Nida Series PC130X.
- ▪ Describe how to construct a simple series circuit using PC130X.
- ▫ Insert and remove a component from the PC130X breadboard card.

5021-912-160 DC Circuit Construction 130X
- ▫ Construct a series circuit.
- ▫ Verify series circuit operation.
- ▫ Construct a parallel circuit.
- ▫ Verify parallel circuit operation.
- ▫ Construct a series-parallel circuit.
- ▫ Verify series-parallel circuit operation.
- ▫ Construct a circuit using various components.
- ▫ Verify circuit operation.

5021-912-190 AC Circuit Construction 130X
- ▫ Construct an AC circuit.
- ▫ Verify AC circuit operation.

5021-912-220 Analog Circuit Construction 130X
- ▫ Construct an analog circuit.
- ▫ Verify analog circuit operation.

LESSON ID/TITLE CARDS/KITS

MOD 35 - CIRCUIT CONSTRUCTION (cont.)

5021-912-250 Digital Circuit Construction 130X
- ▫ Construct a digital circuit.
- ▫ Verify digital circuit operation.

MOD 36 - SOLDERING (LEAD)

5021-914-130 Soldering Safety and Electrostatic Sensitive Devices . . . . . ---
- ▪ Understand the safety requirements of soldering chemicals and supplies.
- ▪ Describe the procedure for use of an eyewash station.
- ▪ Define an electrostatic sensitive device.
- ▪ Describe the sources of electrostatic discharge and list its hazards to electronic components.
- ▪ Identify the static-producing materials in the work area.
- ▪ Explain the principles of static control and methods employed in developing static control facilities.
- ▪ Describe the special handling, identification, packaging, and protection requirements for electrostatic sensitive devices.

5021-914-160 Solder and Soldering Equipment . . . . . ---
- ▪ Identify different types of solder.
- ▪ Identify proper solder flux.
- ▪ Understand how to handle a soldering iron properly.
- ▪ Understand how and why a soldering iron tip is tinned.
- ▪ Understand correct use of safety equipment.
- ▪ Identify hand tools used to aid soldering.
- ▪ Describe proper use of heat sinks and wire forming tools.
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to tin a soldering iron tip properly.

5021-914-170 Solder and Soldering Equipment Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to tin a soldering iron tip properly.

5021-914-190 Wire Stripping, Tinning, and Splicing . . . . . ---
- ▪ Identify different types of wire strippers and trimmers.
- ▪ Identify the proper tools used to strip various wires.
- ▪ Understand how to strip wires using wire strippers.
- ▪ Identify methods of wire tinning.
- ▪ Understand how and when to tin a wire.
- ▪ Identify methods of wire splicing.
- ▪ Understand how and when to splice a wire.
- ▫ Strip wires using the available wire strippers.
- ▫ Demonstrate wire tinning.
- ▫ Demonstrate wire splicing.

5021-914-200 Wire Stripping, Tinning, and Splicing Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly the strip and tin the end of a wire.
- ▫ Demonstrate how to properly make a wire splice.

5021-914-220 Terminal Types and Connections . . . . . ---
- ▪ Understand the IPC/EIA J-STD-001C standards used for turret, bifurcated, and hook terminals.

LESSON ID/TITLE CARDS/KITS

MOD 36 - SOLDERING (LEAD) (cont.)

5021-914-220 Terminal Types and Connections (cont.)
- ▪ Identify turret, bifurcated, and hook terminals.
- ▪ Describe the application of turret, bifurcated, and hook terminals.
- ▪ Understand the IPC/EIA J-STD-001C standards used for pierced and cup turrets.
- ▪ Identify pierced and cup turrets.
- ▪ Describe the application of pierced and cup turrets terminals.
- ▫ Solder connections to a turret terminal.
- ▫ Solder connections to a bifurcated terminal.
- ▫ Solder connections to a hook terminal.
- ▫ Solder connections to a pierced terminal.
- ▫ Solder a connection to a cup terminal.

5021-914-230 Terminal Types and Connections Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly solder a wire to a turret terminal.
- ▫ Demonstrate how to properly solder a wire to a bifurcated terminal.
- ▫ Demonstrate how to properly solder a wire to a hook terminal.
- ▫ Demonstrate how to properly solder a wire to a pierced terminal.
- ▫ Demonstrate how to properly solder a wire to a cup terminal.

5021-914-250 Printed Circuit Board Types and Manufacturing Methods . . . . . ---
- ▪ Identify the general characteristics of PC boards.
- ▪ Identify several connection methods used on PC boards.
- ▪ Identify the options and procedures available for repairing broken circuit board copper lands.
- ▫ Prepare a circuit board for repair using a surface mount jumper.
- ▫ Repair a circuit board using a surface mount jumper.

5021-914-260 Printed Circuit Board Types and Manufacturing Methods Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly prepare a PC board for installation of a surface mount jumper wire.
- ▫ Demonstrate how to properly solder a surface mount jumper wire.

5021-914-280 Through-Hole Non-Polarized Component Soldering and Desoldering . . . . . ---
- ▪ Understand the soldering process.
- ▪ Identify good, cold, flux, and disturbed solder connections.
- ▪ Identify common non-polarized components.
- ▪ Identify tools used to form leads.
- ▪ Understand lead forming methods.
- ▪ Identify the methods used to mount components on a PCB.
- ▪ Understand desoldering methods.
- ▪ Understand how to correct poor solder connections.
- ▫ Form component leads.
- ▫ Mount and solder components to a PCB.
- ▫ Desolder components from a PCB.

5021-914-290 Through-Hole Non-Polarized Component Soldering Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly form the leads of a thru-hole component.
- ▫ Demonstrate how to properly solder non-polarized thru-hole components.
- ▫ Demonstrate how to properly desolder non-polarized thru-hole components.

LESSON ID/TITLE CARDS/KITS

MOD 36 - SOLDERING (LEAD) (cont.)

5021-914-310 Through-Hole Polarized Component Soldering . . . . . ---
- ▪ Identify common polarized components.
- ▪ Identify orientation of components.
- ▪ Explain heat fragility of some components.
- ▫ Form leads of polarized components.
- ▫ Mount polarized components on a PCB.
- ▫ Solder heat-sensitive components on a PCB.
- ▫ Solder polarized components on a PCB.

5021-914-320 Through-Hole Polarized Component Soldering Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly solder polarized thru-hole components.
- ▫ Demonstrate how to properly desolder polarized thru-hole components.

5021-914-340 Soldering Surface Mount Devices . . . . . ---
- ▪ Explain differences between through-hole and SMD technologies.
- ▪ Identify common SMD components.
- ▪ Understand SMD soldering and desoldering techniques.
- ▫ Prepare surface mount pads for soldering of a component.
- ▫ Solder a surface mount resistor to a PCB.
- ▫ Solder a surface mount IC to a PCB.

5021-914-350 Soldering Surface Mount Devices Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly tin a PC board in preparation for installation of surface mount components.
- ▫ Demonstrate how to properly solder surface mount components.
- ▫ Demonstrate how to properly desolder surface mount components.

5021-914-370 Coax Cable Connectors . . . . . ---
- ▪ Review BNC connector history, advantages, and limitations.
- ▪ Review RG-58 cable history, advantages, and limitations.
- ▪ Understand the assembly of the UG-88C/U BNC connector.
- ▪ Understand how a UG-88C/U BNC connector is attached to a coaxial cable.
- ▫ Install a UG-88C/U BNC connector on the RG-58 A/U cable.

5021-914-380 Coax Cable Connectors Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly a BNC connector on a cable.

MOD 37 - LEAD-FREE SOLDERING

5021-916-130 Soldering Safety and Electrostatic Sensitive Devices . . . . . ---
- ▪ Understand the safety requirements of soldering chemicals and supplies.
- ▪ Describe the procedure for use of an eyewash station.
- ▪ Define an electrostatic sensitive device.
- ▪ Describe the sources of electrostatic discharge and list its hazards to electronic components.
- ▪ Identify the static-producing materials in the work area.
- ▪ Explain the principles of static control and methods employed in developing static control facilities.
- ▪ Describe the special handling, identification, packaging, and protection requirements for electrostatic sensitive devices.

LESSON ID/TITLE CARDS/KITS

MOD 37 - LEAD-FREE SOLDERING (cont.)

5021-916-160 Solder and Soldering Equipment . . . . . ---
- ▪ Identify different types of solder.
- ▪ Identify proper solder flux.
- ▪ Understand how to handle a soldering iron properly.
- ▪ Understand how and why a soldering iron tip is tinned.
- ▪ Understand correct use of safety equipment.
- ▪ Identify hand tools used to aid soldering.
- ▪ Describe proper use of heat sinks and wire forming tools.
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to tin a soldering iron tip properly.

5021-916-170 Solder and Soldering Equipment Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to tin a soldering iron tip properly.

5021-916-190 Wire Stripping, Tinning, and Splicing . . . . . ---
- ▪ Identify different types of wire strippers and trimmers.
- ▪ Identify the proper tools used to strip various wires.
- ▪ Understand how to strip wires using wire strippers.
- ▪ Identify methods of wire tinning.
- ▪ Understand how and when to tin a wire.
- ▪ Identify methods of wire splicing.
- ▪ Understand how and when to splice a wire.
- ▫ Strip wires using the available wire strippers.
- ▫ Demonstrate wire tinning.
- ▫ Demonstrate wire splicing.

5021-916-200 Wire Stripping, Tinning, and Splicing Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly the strip and tin the end of a wire.
- ▫ Demonstrate how to properly make a wire splice.

5021-916-220 Terminal Types and Connections . . . . . ---
- ▪ Understand the IPC/EIA J-STD-001C standards used for turret, bifurcated, and hook terminals.
- ▪ Identify turret, bifurcated, and hook terminals.
- ▪ Describe the application of turret, bifurcated, and hook terminals.
- ▪ Understand the IPC/EIA J-STD-001C standards used for pierced and cup turrets.
- ▪ Identify pierced and cup turrets.
- ▪ Describe the application of pierced and cup turrets terminals.
- ▫ Solder connections to a turret terminal.
- ▫ Solder connections to a bifurcated terminal.
- ▫ Solder connections to a hook terminal.
- ▫ Solder connections to a pierced terminal.
- ▫ Solder a connection to a cup terminal.

5021-916-230 Terminal Types and Connections Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly solder a wire to a turret terminal.
- ▫ Demonstrate how to properly solder a wire to a bifurcated terminal.
- ▫ Demonstrate how to properly solder a wire to a hook terminal.
- ▫ Demonstrate how to properly solder a wire to a pierced terminal.

LESSON ID/TITLE CARDS/KITS

MOD 37 - LEAD-FREE SOLDERING (cont.)

5021-916-230 Terminal Types and Connections Practical Exam (cont.)
- ▫ Demonstrate how to properly solder a wire to a cup terminal.

5021-916-250 Printed Circuit Board Types and Manufacturing Methods . . . . . ---
- ▪ Identify the general characteristics of PC boards.
- ▪ Identify several connection methods used on PC boards.
- ▪ Identify the options and procedures available for repairing broken circuit board copper lands.
- ▫ Prepare a circuit board for repair using a surface mount jumper.
- ▫ Repair a circuit board using a surface mount jumper.

5021-916-260 Printed Circuit Board Types and Manufacturing Methods Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly prepare a PC board for installation of a surface mount jumper wire.
- ▫ Demonstrate how to properly solder a surface mount jumper wire.

5021-916-280 Through-Hole Non-Polarized Component Soldering and Desoldering . . . . . ---
- ▪ Understand the soldering process.
- ▪ Identify good, cold, flux, and disturbed solder connections.
- ▪ Identify common non-polarized components.
- ▪ Identify tools used to form leads.
- ▪ Understand lead forming methods.
- ▪ Identify the methods used to mount components on a PCB.
- ▪ Understand desoldering methods.
- ▪ Understand how to correct poor solder connections.
- ▫ Form component leads.
- ▫ Mount and solder components to a PCB.
- ▫ Desolder components from a PCB.

5021-916-290 Through-Hole Non-Polarized Component Soldering Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly form the leads of a thru-hole component.
- ▫ Demonstrate how to properly solder non-polarized thru-hole components.
- ▫ Demonstrate how to properly desolder non-polarized thru-hole components.

5021-916-310 Through-Hole Polarized Component Soldering . . . . . ---
- ▪ Identify common polarized components.
- ▪ Identify orientation of components.
- ▪ Explain heat fragility of some components.
- ▫ Form leads of polarized components.
- ▫ Mount polarized components on a PCB.
- ▫ Solder heat-sensitive components on a PCB.
- ▫ Solder polarized components on a PCB.

5021-916-320 Through-Hole Polarized Component Soldering Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly solder polarized thru-hole components.
- ▫ Demonstrate how to properly desolder polarized thru-hole components.

5021-916-340 Soldering Surface Mount Devices . . . . . ---
- ▪ Explain differences between through-hole and SMD technologies.
- ▪ Identify common SMD components.
- ▪ Understand SMD soldering and desoldering techniques.
- ▫ Prepare surface mount pads for soldering of a component.

LESSON ID/TITLE CARDS/KITS

MOD 37 - LEAD-FREE SOLDERING (cont.)

5021-916-340 Soldering Surface Mount Devices (cont.)
- ▫ Solder a surface mount resistor to a PCB.
- ▫ Solder a surface mount IC to a PCB.

5021-916-350 Soldering Surface Mount Devices Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly tin a PC board in preparation for installation of surface mount components.
- ▫ Demonstrate how to properly solder surface mount components.
- ▫ Demonstrate how to properly desolder surface mount components.

5021-916-370 Coax Cable Connectors . . . . . ---
- ▪ Review BNC connector history, advantages, and limitations.
- ▪ Review RG-58 cable history, advantages, and limitations.
- ▪ Understand the assembly of the UG-88C/U BNC connector.
- ▪ Understand how a UG-88C/U BNC connector is attached to a coaxial cable.
- ▫ Install a UG-88C/U BNC connector on the RG-58 A/U cable.

5021-916-380 Coax Cable Connectors Practical Exam . . . . . ---
- ▫ Use safety equipment properly.
- ▫ Demonstrate how to properly a BNC connector on a cable.

MOD 38 - CABLES AND CONNECTORS

5021-216-130 Cables, Connectors, and Tools . . . . . ---
- ▪ Define wire.
- ▪ Define cable.
- ▪ Define harness.
- ▪ Identify solid and stranded wires.
- ▪ Understand the purpose of a connector.
- ▪ Determine the difference between a plug and jack.
- ▪ Understand connector terminology.
- ▪ Understand the purpose of cutters.
- ▪ Understand the purpose of crimpers.
- ▪ Understand the purpose of a multimeter.
- ▪ Understand the purpose of a cable tester.

5021-216-160 Single Wire Assemblies w7
- ▪ Identify the steps used to prepare, build, and test single wire assemblies.
- ▫ Assemble a FASTON type connector.
- ▫ Assemble a butt splice.
- ▫ Assemble a 0.156 KK Series connector.
- ▫ Build and test single wire assemblies without guidance.

5021-216-190 Flat Satin Cable and RJ Connectors w6
- ▪ Describe flat satin cable.
- ▪ Understand flat satin cable applications.
- ▪ Describe the RJ11 connector.
- ▪ Describe the RJ45 connector.
- ▪ Understand RJ11 and RJ45 applications.
- ▫ Assemble an RJ14 cable.
- ▫ Assemble an RJ45 cable.

LESSON ID/TITLE CARDS/KITS

MOD 38 - CABLES AND CONNECTORS (cont.)

5021-216-190 Flat Satin Cable and RJ Connectors (cont.)
- ▫ Build and test flat satin cable assemblies without guidance.

5021-216-220 Cabling Standards and Categories of Performance . . . . . ---
- ▪ Understand the origin of cabling standards.
- ▪ Know the agencies responsible for establishing standards.
- ▪ Define Universal Service Ordering Codes.
- ▪ Understand the types of serial data connections.
- ▪ Describe characteristics of a multi-conductor cable.
- ▪ Describe characteristics of a flat satin cable.
- ▪ Describe characteristics of a twisted pair cable.
- ▪ Describe characteristics of a coaxial cable.
- ▪ Identify UTP, SCTP, and STP cable.
- ▪ Understand Cat 1 through Cat 7 cable properties.

5021-216-250 Twisted Pair Cable W6
- ▪ Identify and describe how a modular RJ45 plug is used.
- ▪ Identify and describe how a keystone jack is used.
- ▪ Identify the difference between an ATT 110 punchdown type jack and a CAT 5 TIA/EIA-568-A/B keystone type jack.
- ▪ Identify and describe how CAT 5 UTP cable is used.
- ▪ Understand T568A, T568B, and 10BASE-T wiring standards.
- ▪ Understand straight-through and cross-over wiring methods.
- ▫ Understand how to prepare CAT 5 UTP cable for assembly with an RJ45 modular plug and CAT 5 TIA/EIA-568-A/B keystone type jack.
- ▫ Identify the tools used to attach a modular RJ45 plug and CAT 5 TIA/EIA-568-A/B keystone type jack to CAT 5 UTP.
- ▫ Understand how to attach a CAT 5 TIA/EIA-568-A/B keystone type jack to a UTP cable following T568A standards.
- ▫ Prepare, build, and test a CAT 5 UTP cable with RJ45 plugs following T568A standards and the straight-through wiring method without guidance.
- ▫ Prepare, build, and test CAT 5 UTP cable with a CAT 5 TIA/EIA-568-A/B keystone type jack following T568A standards and the straight-through wiring method.

5021-216-280 Multi-Wire Cable W7
- ▪ Describe a multi-wire cable.
- ▪ Identify a D-Sub connector.
- ▪ Understand how a D-Sub connector is used.
- ▪ Understand the purpose of DCE and DTE devices.
- ▪ Identify DCE and DTE cable configurations.
- ▫ Identify and examine the parts and types of D-Sub connectors.
- ▫ Examine the RS-232 wiring standard.
- ▫ Prepare, build, and test a multi-wire cable assembly using a D-Sub connector and RS-232 standards.
- ▫ Prepare, build, and test multi-wire cable assemblies without guidance.

5021-216-310 Coaxial Cable W6
- ▪ Describe the parts of a coaxial cable.
- ▪ Recognize types of coaxial cable.
- ▪ Identify coaxial cable applications.
- ▪ Recognize an F-type coaxial connector.

LESSON ID/TITLE CARDS/KITS

MOD 38 - CABLES AND CONNECTORS (cont.)

5021-216-310 Coaxial Cable (cont.)
- ▪ Recognize a BNC coaxial connector.
- ▫ Understand how to prepare a coaxial cable for assembly with an F-type connector and a BNC connector.
- ▫ Identify the tools used to construct a coaxial cable assembly.
- ▫ Understand how to test a coaxial cable assembly with a multimeter.
- ▫ Prepare, build, and test a coaxial cable assembly with F-type connectors.
- ▫ Prepare, build, and test a coaxial cable assembly with BNC type connectors.

5021-216-920 Cables and Connectors Post-Test (Theory) . . . . . ---

MOD 39 - TRANSDUCER SYSTEMS

5142-112-130 Introduction to Transducers . . . . . ---
- ▪ Identify types of transducers.
- ▪ Understand transducer operating principles.

5142-112-160 Nature of Light . . . . . ---
- ▪ Describe optoelectronics.
- ▪ Describe the classification of optoelectronics devices.
- ▪ Describe light.
- ▪ Describe photometric and radiometric energy.

5142-112-190 Light Transducers . . . . . ---
- ▪ Describe the ratings of light sources.
- ▪ Describe incandescent lamps.
- ▪ Describe LEDs.
- ▪ Describe the ratings of light sensors.
- ▪ Describe photocells.
- ▪ Describe photodiodes.
- ▪ Describe photovoltaics.
- ▪ Describe phototransistors.

5142-112-220 Light Transducer Operation 251
- ▫ Observe the operation of typical light transmitters.
- ▫ Measure voltage characteristics of typical light transmitters.
- ▫ Observe the operation of typical light receivers.
- ▫ Measure the resistance/current/voltage characteristics of typical light receivers.

5142-112-250 Nature of Heat . . . . . ---
- ▪ Describe thermo-electronics.
- ▪ Describe the classification of thermo-electronic devices.
- ▪ Describe heat.
- ▪ Describe heat measuring systems.
- ▪ Describe heat units.

5142-112-280 Heat Transducers . . . . . ---
- ▪ Describe IR heat generators.
- ▪ Describe thermal resistance.
- ▪ Describe heat dissipation.
- ▪ Describe mechanical heat sensors.
- ▪ Describe thermocouples.
- ▪ Describe thermistors.

LESSON ID/TITLE CARDS/KITS

MOD 39 - TRANSDUCER SYSTEMS (cont.)

5142-112-280 Heat Transducers (cont.)
- ▪ Describe resistance temperature detectors.
- ▪ Describe solid state sensors.

5142-112-310 Heat Transducer Operation 252
- ▫ Observe the operation of typical heat sensors.
- ▫ Measure the resistance and voltage output of typical heat sensors.
- ▫ Determine the sensitivity of typical heat sensors.

5142-114-130 Nature of Motion . . . . . ---
- ▪ Define motion.
- ▪ Describe distance and velocity as related to motion.
- ▪ Describe acceleration as related to motion.
- ▪ Define circular motion.
- ▪ Describe rotations per minute as related to circular motion.
- ▪ Describe runout rate and runout distance as related to circular motion.

5142-114-160 Motion Transducers . . . . . ---
- ▪ Describe photointerrupter motion sensors.
- ▪ Describe photoreflector motion sensors.
- ▪ Describe magnetic pickup motion sensors.
- ▪ Describe velocity circuits.
- ▪ Describe acceleration circuits.
- ▪ Describe rpm circuits.

5142-114-190 Motion Transducer Operation 255
- ▫ Observe the operation of typical motion sensors.
- ▫ Measure the rpm and velocity output of typical motion sensors.
- ▫ Measure acceleration/deceleration using an oscilloscope.

5142-114-220 Nature of Position . . . . . ---
- ▪ Define position.
- ▪ Describe positional devices.
- ▪ Describe the characteristics of prime movers.
- ▪ Calculate various output quantities of prime movers.

5142-114-250 Position Transducers . . . . . ---
- ▪ Describe analog angular position sensors.
- ▪ Describe analog linear position sensors.
- ▪ Describe digital angular position sensors.
- ▪ Describe digital linear position sensors.

5142-114-280 Position Transducer Operation 256, 257
- ▫ Observe the operation of an encoder position sensor.
- ▫ Measure the output signals in an encoder position sensor.
- ▫ Observe the operation of an increment position sensor.

MOD 40 - INTRODUCTION TO MOTORS

5142-312-130 Introduction to Rotating Machinery . . . . . ---
- ▪ Describe the various devices that are called rotating machinery.
- ▪ Describe Speed, Torque, Counter Electromotive Force (CEMF), Loads, Power, and Efficiency in rotating machinery.

LESSON ID/TITLE CARDS/KITS

MOD 40 - INTRODUCTION TO MOTORS (cont.)

MOD 41 - MOTOR CONTROL SYSTEMS

LESSON ID/TITLE CARDS/KITS

MOD 41 - MOTOR CONTROL SYSTEMS (cont.)

5142-314-250 Open Loop Motor System Experiment 178, 179
- ▫ Describe an open loop motor system.
- ▫ Examine simple block diagrams of open loop systems.
- ▫ List the terminal characteristics of an armature-controlled motor.
- ▫ Measure circuit frequency and calculate rpm.
- ▫ Measure armature voltages.
- ▫ Measure armature current under locked and unlocked rotor conditions.

5142-318-130 Motion Detection 177, 178, 179
- ▪ Identify the characteristics of linear motion.
- ▪ Identify the characteristics of circular motion and motion transducers.
- ▫ Compute linear and rotary motion rates based on system mechanical and electrical parameters.
- ▫ Analyze motion to frequency for rpm and velocity.
- ▫ Analyze motion to analog DC for rpm and velocity.

5142-318-160 Error Detection and Feedback 177, 178, 179
- ▪ Describe a closed loop feedback controlled motor system.
- ▪ Identify simple block diagrams of closed loop systems.
- ▪ List the functions that a closed loop feedback system performs.
- ▫ Measure the error and feedback signals in a closed loop DC motor system.

5142-318-190 Troubleshooting Closed Loop Systems 177, 178, 179
- ▪ Describe the four-step process of basic troubleshooting.
- ▪ Describe component isolation, signal tracing, and signal injection.
- ▫ Trace signal flow through a closed loop feedback system.
- ▫ Troubleshoot and fault isolate to the circuit level of a closed loop feedback system.

5142-318-220 Position Detection 177, 178, 179
- ▪ Define position.
- ▪ Describe positional devices.
- ▪ Describe the characteristics of rotational position generators.
- ▪ Calculate various output quantities of motor position generators.
- ▪ Describe analog angular position sensors.
- ▪ Describe analog linear position sensors.
- ▪ Describe digital angular position sensors.
- ▪ Describe digital linear position sensors.
- ▫ Compute linear and rotary position based on electrical and mechanical circuit parameters.
- ▫ Analyze the position detection operation of an encoder wheel with CCW/CW sensing.

5142-318-250 Proportional, Integral, and Derivative Control System . . . . . ---
- ▪ Identify the principles of proportional and derivative control.
- ▪ Identify the principles of proportional and integral control.
- ▪ Identify the principles of proportional, integral, and derivative control.

5142-318-280 PID Control System Experiment 177, 178, 179
- ▫ Identify the proportional, integral, and derivative circuits.
- ▫ Adjust the PID proportional gain.
- ▫ Adjust the PID integral reset control.
- ▫ Adjust the PID derivative rate control.

LESSON ID/TITLE CARDS/KITS

MOD 42 - SYNCHRO SERVO SYSTEMS

5142-512-130 Introduction to Synchros . . . . . ---
- State the definition of a synchro.
- Identify synchro schematic symbols.
- Identify the basic design of a synchro.
- Demonstrate knowledge of the function of the torque transmitter and the torque receiver.

5142-512-160 Differential Transmitters . . . . . ---
- State the definition of the torque differential transmitter used in a synchro system.
- Identify the synchro torque differential transmitter schematic symbol.
- Understand the functions of a torque differential transmitter.

5142-512-190 Control Synchro Systems . . . . . ---
- Describe the differences between torque synchro systems and control synchro systems.
- Identify control synchro schematic symbols.
- Demonstrate knowledge of the functions of the control transformer and control transolver.

5142-512-220 Troubleshooting Synchro Systems . . . . . ---
- Recognize symptoms of rotor winding failures in synchro systems.
- Recognize symptoms of stator winding failures in synchro systems.
- Demonstrate knowledge of the troubleshooting methods and techniques in repairing synchro systems.

5142-512-250 Stabilized Platforms . . . . . ---
- Define the terms, abbreviations, and symbols associated with gyros.
- Describe the principles of operation of a gyroscope.
- Describe the construction of a gyroscope.
- Define the terms, abbreviations, and symbols associated with stabilized platforms and accelerometers.
- Describe the principles of operation of a stabilized platform.

5142-512-920 Synchro/Servo Systems Post-Test (Theory) . . . . . ---

MOD 43 - HYDRAULIC AND PNEUMATIC SYSTEMS

5142-412-130 Introduction to Hydraulic Systems . . . . . ---
- Describe hydraulics.
- Understand the concept of hydraulics.
- Realize hydraulic applications.
- Understand basic hydraulic safety.
- Describe a basic hydraulic system and its components.
- Describe different system components and their schematic symbols.

5142-412-160 Introduction to Pneumatic Systems . . . . . ---
- Describe pneumatics.
- Understand the concept of pneumatics.
- Realize pneumatic applications.
- Understand basic pneumatic applications.
- Describe a basic pneumatic system and its components.
- Describe different system components and their schematic symbols.

5142-412-190 Fluid System Valve Operation . . . . . ---
- Recognize valves used in hydraulics and pneumatics.
- Demonstrate the knowledge of the theory and applications of valves used in hydraulics and pneumatics.

LESSON ID/TITLE CARDS/KITS

MOD 43 - HYDRAULIC AND PNEUMATIC SYSTEMS (cont.)

5142-412-220 Hydraulic and Pneumatic Pumps . . . . . ---
- ▪ Recognize the types of pumps used in hydraulic systems.
- ▪ Demonstrate the knowledge of pump operation and application.
- ▪ Understand the causes of common pump failures.
- ▪ Describe the basic repairs needed to restore pump operation.
- ▪ Recognize the types of pumps used in pneumatic systems.
- ▪ Demonstrate the knowledge of pump operation and application.
- ▪ Understand the causes of common pump failures.
- ▪ Describe the basic repairs needed to restore pump operation.

5142-412-250 Troubleshooting Hydraulic and Pneumatic Systems . . . . . ---
- ▪ Recognize the symptoms of common hydraulic and pneumatic component failures.
- ▪ Demonstrate component troubleshooting procedures.

MOD 44 - PROGRAMMABLE LOGIC CONTROLLERS

5142-612-130 Introduction to Programmable Logic Controllers 1
- ▪ Recognize a basic PLC block diagram.
- ▪ Identify basic PLC functions.
- ▪ Identify PLC principles of operation.
- ▪ Recognize and understand a simple ladder logic diagram.
- ▪ Recognize the symbols used in a basic ladder logic diagram.
- ▫ Use the PLC trainer to control LEDs.
- ▫ Use the PLC trainer to control the motor.
- ▫ Understand how the PLC's operation changes by changing the ladder logic programs.

5142-612-160 PLC Trainer Familiarization 1
- ▪ Identify the power requirements for the Nida Model 5050 PLC trainer.
- ▪ Recognize trainer controls, switches, and indicating devices.
- ▫ Identify an experiment card.
- ▫ Describe insertion and removal procedures.
- ▫ Perform procedures to start an experiment.
- ▫ Insert and remove an experiment card.
- ▫ Perform procedures to end an experiment.

5142-612-190 PLC Hardware 1
- ▪ Understand the functions of I/O modules.
- ▪ Identify the different types of I/O modules.
- ▪ Know the basic operation of both discrete and analog I/O modules.
- ▪ Know the function of the processor module's microprocessor (CPU).
- ▪ Describe a memory map and the different memory functions.
- ▪ Know the purpose of the communications circuitry.
- ▪ Understand the scan cycle.
- ▫ Use an analog I/O module for analog input and output devices.
- ▫ Use an analog I/O module for an analog input device with a relay I/O module for an LED output.
- ▫ Observe the processor module's operation using the scan cycle.

5142-612-220 PLC Programming 1
- ▪ Understand the arrangement of input instructions for AND and OR operations.
- ▪ Identify different input instructions.

LESSON ID/TITLE CARDS/KITS

MOD 44 - PROGRAMMABLE LOGIC CONTROLLERS (cont.)

5142-612-220 PLC Programming (cont.)
- ▪ Identify different output instructions.
- ▪ Use a four step process to develop an organized programming strategy.
- ▪ Identify the correct ladder logic program for a specified process.
- ▫ Use a four step process to develop an organized programming strategy.
- ▫ Identify the correct ladder logic program for a specified process.

5142-612-250 PLC Troubleshooting 1, 2
- ▪ Use a four step process to develop an organized troubleshooting strategy.
- ▪ Identify areas of a PLC controlled system most likely to fail.
- ▪ Identify areas of a PLC controlled system least likely to fail.
- ▫ Observe and understand the normal operation of a PLC controlled system.
- ▫ Recognize a faulty PLC controlled system.
- ▫ Identify the possible causes of the fault.

5142-614-160 RSLogix Familiarization . . . . . ---
- ▫ Understand the different file types associated with the PLC.
- ▫ Recognize the importance of proper configuration settings.
- ▪ Understand the process for creating ladder programs.
- ▪ Develop an understanding of commands used for ladder program development.
- ▪ Identify the different modes of operation of the PLC.
- ▪ Understand the usage of each processor mode.
- ▪ Understand the steps required to transfer a file to and from the PLC.

5142-614-190 Bit Instructions 1
- ▪ Understand the concepts of bit instructions.
- ▪ Describe the operation of bit instructions.
- ▫ Demonstrate the usage of bit instructions with Rockwell RSLogix software.

5142-614-220 Timer and Counter Instructions 1
- ▪ Understand the concepts of timer instructions.
- ▪ Describe the operation of timer instructions.
- ▪ Understand the concepts of counter instructions.
- ▪ Describe the operation of counter instructions.
- ▫ Demonstrate the usage of timer and counter instructions using Rockwell RSLogix software.

5142-614-250 I/O and Interrupt Instructions 1
- ▪ Understand the concepts of I/O instructions.
- ▪ Describe the operation of I/O instructions.
- ▪ Understand the concepts of interrupt instructions.
- ▪ Describe the operation of interrupt instructions.
- ▫ Demonstrate the usage of I/O instructions using Rockwell RSLogix software.

5142-614-280 Comparison Instructions 1
- ▪ Understand the concepts of comparison instructions.
- ▪ Describe the operation of comparison instructions.
- ▫ Demonstrate the usage of comparison instructions using Rockwell RSLogix software.

5142-614-310 Math Instructions 1
- ▪ Understand the concepts of math instructions.
- ▪ Describe the operation of math instructions.
- ▫ Demonstrate the usage of math instructions using Rockwell RSLogix software.

5142-614-340 Move and Logical Instructions 1
- ▪ Understand the concepts of move instructions.

LESSON ID/TITLE CARDS/KITS

MOD 44 - PROGRAMMABLE LOGIC CONTROLLERS (cont.)

5142-614-340 Move and Logical Instructions (cont.)
- ▪ Describe the operation of move instructions.
- ▪ Understand the concepts of logic instructions.
- ▪ Describe the operation of logic instructions.
- ▫ Demonstrate the usage of move and logic instructions using Rockwell RSLogix software.

5142-614-370 File Instructions 1
- ▪ Understand the concepts of file instructions.
- ▪ Describe the operation of file instructions.
- ▫ Demonstrate the usage of file instructions using Rockwell RSLogix software.

5142-614-400 Bit Shift, FIFO, and LIFO Instructions 1
- ▪ Understand the concepts of bit shift, FIFO, and LIFO instructions.
- ▪ Describe the operation of bit shift, FIFO, and LIFO instructions.
- ▫ Demonstrate the usage of bit shift instructions using Rockwell RSLogix software.

5142-614-430 Sequencer Instructions 1
- ▪ Understand the concepts of the sequencer instructions.
- ▪ Describe the operation of the sequencer instructions.
- ▫ Demonstrate the usage of sequencer instructions using Rockwell RSLogix software.

5142-614-460 Control Instructions 1
- ▪ Understand the concepts of the control instructions.
- ▪ Describe the operation of the control instructions.
- ▫ Demonstrate the usage of control instructions using Rockwell RSLogix software.

5142-614-160 RSLogix Familiarization . . . . . ---
- ▫ Understand the different file types associated with the PLC.
- ▫ Recognize the importance of proper configuration settings.
- ▪ Understand the process for creating ladder programs.
- ▪ Develop an understanding of commands used for ladder program development.
- ▪ Identify the different modes of operation of the PLC.
- ▪ Understand the usage of each processor mode.
- ▪ Understand the steps required to transfer a file to and from the PLC.

5142-614-190 Bit Instructions 1
- ▪ Understand the concepts of bit instructions.
- ▪ Describe the operation of bit instructions.
- ▫ Demonstrate the usage of bit instructions with Rockwell RSLogix software.

5142-614-220 Timer and Counter Instructions 1
- ▪ Understand the concepts of timer instructions.
- ▪ Describe the operation of timer instructions.
- ▪ Understand the concepts of counter instructions.
- ▪ Describe the operation of counter instructions.
- ▫ Demonstrate the usage of timer and counter instructions using Rockwell RSLogix software.

5142-614-250 I/O and Interrupt Instructions 1
- ▪ Understand the concepts of I/O instructions.
- ▪ Describe the operation of I/O instructions.
- ▪ Understand the concepts of interrupt instructions.
- ▪ Describe the operation of interrupt instructions.
- ▫ Demonstrate the usage of I/O instructions using Rockwell RSLogix software.

5142-614-280 Comparison Instructions 1
- ▪ Understand the concepts of comparison instructions.

LESSON ID/TITLE CARDS/KITS

MOD 44 - PROGRAMMABLE LOGIC CONTROLLERS (cont.)

5142-614-280 Comparison Instructions (cont.)
- ▪ Describe the operation of comparison instructions.
- ▫ Demonstrate the usage of comparison instructions using Rockwell RSLogix software.

5142-614-310 Math Instructions 1
- ▪ Understand the concepts of math instructions.
- ▪ Describe the operation of math instructions.
- ▫ Demonstrate the usage of math instructions using Rockwell RSLogix software.

5142-614-340 Move and Logical Instructions 1
- ▪ Understand the concepts of move instructions.
- ▪ Describe the operation of move instructions.
- ▪ Understand the concepts of logic instructions.
- ▪ Describe the operation of logic instructions.
- ▫ Demonstrate the usage of move and logic instructions using Rockwell RSLogix software.

5142-614-370 File Instructions 1
- ▪ Understand the concepts of file instructions.
- ▪ Describe the operation of file instructions.
- ▫ Demonstrate the usage of file instructions using Rockwell RSLogix software.

5142-614-400 Bit Shift, FIFO, and LIFO Instructions 1
- ▪ Understand the concepts of bit shift, FIFO, and LIFO instructions.
- ▪ Describe the operation of bit shift, FIFO, and LIFO instructions.
- ▫ Demonstrate the usage of bit shift instructions using Rockwell RSLogix software.

5142-614-430 Sequencer Instructions 1
- ▪ Understand the concepts of the sequencer instructions.
- ▪ Describe the operation of the sequencer instructions.
- ▫ Demonstrate the usage of sequencer instructions using Rockwell RSLogix software.

5142-614-460 Control Instructions 1
- ▪ Understand the concepts of the control instructions.
- ▪ Describe the operation of the control instructions.
- ▫ Demonstrate the usage of control instructions using Rockwell RSLogix software.

MOD 45 - SIGNAL PROCESSING

5101-112-130 Communications Systems and Signal Processing . . . . . ---
- ▪ Describe the basic elements that compose a communications system.
- ▪ State the two fundamental limiting factors in a communications system.
- ▪ Describe the basic differences between analog and digital signals.
- ▪ Describe signal processing.
- ▪ Identify various signal processing techniques.

5101-112-160 Amplitude Modulation . . . . . ---
- ▪ Describe amplitude modulation (AM).
- ▪ Describe the characteristics of amplitude modulation.
- ▫ Generate amplitude modulation signals using a function generator.
- ▫ Observe and measure the characteristics of an amplitude modulated signal.

5101-112-190 Frequency Modulation . . . . . ---
- ▪ Describe frequency modulation (FM).
- ▪ Describe the characteristics of frequency modulation.
- ▫ Generate frequency modulation signals using a function generator.

LESSON ID/TITLE CARDS/KITS

MOD 45 - SIGNAL PROCESSING (cont.)

5101-112-190 Frequency Modulation (cont.)
- ▫ Observe and measure the characteristics of a frequency modulated signal.

5101-112-220 Single Sideband and Transmission Lines ... ---
- ▪ Identify the Single Sideband operating principle.
- ▪ Identify the operation of a Single Sideband transmitter and receiver.
- ▪ Identify transmission line operating characteristics.
- ▪ Identify the different types of transmission lines.

5101-114-130 AM Circuits ... ---
- ▪ Describe a diode AM modulator circuit.
- ▪ Describe a transistor collector AM modulator circuit.
- ▪ Describe a transistor series AM modulator circuit.
- ▪ Describe a diode AM demodulator circuit.
- ▪ Describe a transistor AM demodulator circuit.

5101-114-160 Basic AM Circuit Construction ... 130X, 322
- ▫ Construct an AM diode modulator circuit.
- ▫ Measure signals in an AM diode modulator circuit.
- ▫ Construct an AM diode demodulator circuit.
- ▫ Measure signals in an AM diode demodulator circuit.

5101-114-190 AM Circuit Operation ... 91, 92
- ▫ Observe the operation of a transistor collector modulator transmitter.
- ▫ Measure signals in a transistor collector modulator transmitter.
- ▫ Observe the operation of a diode demodulator receiver.
- ▫ Measure signals in a diode demodulator receiver.

5101-114-220 AM Circuit Troubleshooting ... 91, 92
- ▫ Determine if an AM transmitter and receiver system is operating correctly.
- ▫ Identify the faulted circuit in a malfunctioning AM transmitter and receiver system.

5101-116-130 FM Circuits ... ---
- ▪ Describe a reactance modulator circuit.
- ▪ Describe a varactor modulator circuit.
- ▪ Describe an IC voltage controlled oscillator modulator circuit.
- ▪ Describe a slope demodulator circuit.
- ▪ Describe a discriminator demodulator circuit.
- ▪ Describe a ratio demodulator circuit.
- ▪ Describe phase lock loop circuits to the block diagram level.
- ▪ Describe phase lock loop FM demodulators.

5101-116-160 Basic FM Circuit Construction ... 130X
- ▫ Construct an FM reactance modulator circuit.
- ▫ Measure signals in an FM reactance modulator circuit.
- ▫ Construct an FM slope demodulator circuit.
- ▫ Measure signals in an FM slope demodulator circuit.

5101-116-220 IC FM Circuit Operation ... 336
- ▫ Observe the operation of an integrated circuit transmitter and receiver.
- ▫ Measure signals in an integrated circuit transmitter and receiver.

5101-116-280 Analog Pulse Modulation ... ---
- ▪ Define analog pulse modulation.
- ▪ Describe pulse amplitude modulation.
- ▪ Describe pulse width modulation.

LESSON ID/TITLE CARDS/KITS

MOD 45 - SIGNAL PROCESSING (cont.)

5101-116-280 Analog Pulse Modulation (cont.)
- ▪ Describe pulse position modulation.

5101-122-130 Pulse Code Modulation (PCM) . . . . . ---
- ▪ Describe pulse code modulation (PCM).
- ▪ Describe the characteristics of PCM signals.
- ▪ Describe the block diagram of a PCM modulator.
- ▪ Describe a typical PCM modulator circuit.
- ▪ Describe the block diagram of a PCM demodulator.
- ▪ Describe a typical PCM demodulator circuit.

5101-122-160 PCM Circuit Operation 326, 284, 327
- ▫ Observe the operation of a typical PCM modulator.
- ▫ Measure signals in a typical PCM modulator.
- ▫ Observe the operation of a typical PCM demodulator.
- ▫ Measure signals in a typical PCM demodulator.

5101-122-190 PCM Circuit Troubleshooting 326, 327
- ▫ Determine if a PCM transmitter and receiver system is operating correctly.
- ▫ Identify the faulted component in a malfunctioning PCM transmitter and receiver system.

5101-124-130 Delta Modulation (DM) . . . . . ---
- ▪ Describe Delta Modulation.
- ▪ Describe the characteristics of DM signals.
- ▪ Describe a typical DM modulator circuit.
- ▪ Describe the CVSD DM modulator integrated circuit.
- ▪ Describe a typical DM demodulator circuit.
- ▪ Describe the CVSD DM demodulator integrated circuit.

5101-124-160 Delta Modulation (DM) Circuit Operation 332, 333
- ▫ Observe the operation of a typical DM modulator.
- ▫ Measure signals in a typical DM modulator.
- ▫ Observe the operation of a typical DM demodulator.
- ▫ Measure signals in a typical DM demodulator.

5101-124-190 DM Circuit Troubleshooting 332, 333
- ▫ Determine if a DM transmitter and receiver system is operating correctly.
- ▫ Identify the faulted component in a malfunctioning DM transmitter and receiver system.

5101-126-130 Frequency Shift Keying (FSK) . . . . . ---
- ▪ Describe Frequency Shift Keying.
- ▪ Describe the characteristics of FSK signals.
- ▪ Describe a typical FSK modulator circuit.
- ▪ Describe the MC14066 analog switch and ICL8038 VCO integrated circuits.
- ▪ Describe a typical FSK demodulator circuit.
- ▪ Describe the NE565 and NE567 PLL integrated circuits.

5101-126-160 Frequency Shift Keying Circuit Operation 328, 329
- ▫ Observe the operation of a typical FSK modulator.
- ▫ Measure signals in a typical FSK modulator.
- ▫ Observe the operation of a typical FSK demodulator.
- ▫ Measure signals in a typical FSK demodulator.

5101-126-190 FSK Circuit Troubleshooting 328, 329
- ▫ Determine if an FSK transmitter and receiver system is operating correctly.
- ▫ Identify the faulted component in a malfunctioning FSK transmitter and receiver system.

LESSON ID/TITLE CARDS/KITS

MOD 45 - SIGNAL PROCESSING (cont.)

5101-128-130 Phase Shift Keying (PSK) . . . . . ---
- ▪ Describe Phase Shift Keying.
- ▪ Describe the characteristics of PSK signals.
- ▪ Describe a typical PSK modulator circuit.
- ▪ Describe a typical PSK demodulator circuit.

5101-128-160 Phase Shift Keying Circuit Operation 323, 330, 331
- ▫ Observe the operation of a typical PSK modulator.
- ▫ Measure signals in a typical PSK modulator.
- ▫ Observe the operation of a typical PSK demodulator.
- ▫ Measure signals in a typical PSK demodulator.

5101-128-190 PSK Circuit Troubleshooting 323, 330, 331
- ▫ Determine if a PSK/QPSK transmitter and receiver system is operating correctly.
- ▫ Identify the faulted component in a malfunctioning PSK/QPSK transmitter and receiver system.

5101-132-130 Time Division Multiplexing (TDM) . . . . . ---
- ▪ Describe Time Division Multiplexing.
- ▪ Describe the characteristics of TDM signals.
- ▪ Describe a typical TDM multiplexer circuit.
- ▪ Describe the MC14051 circuit used as a TDM multiplexer.
- ▪ Describe a typical TDM demultiplexer circuit.
- ▪ Describe the MC14051 circuit used as a TDM demultiplexer.

5101-132-160 Time Division Multiplexing Circuit Operation 305, 306, 322
- ▪ Observe the operation of a typical TDM multiplexer.
- ▪ Observe the operation of a typical TDM demultiplexer.
- ▫ Perform alignments in a typical TDM circuit.
- ▫ Measure signals in a typical TDM circuit.

5101-132-190 TDM Circuit Troubleshooting 305, 306, 322
- ▫ Determine if a TDM transmitter and receiver system is operating correctly.
- ▫ Identify the faulted component in a malfunctioning TDM transmitter and receiver system.

5101-134-130 Frequency Division Multiplexing (FDM) . . . . . ---
- ▪ Describe Frequency Division Multiplexing.
- ▪ Describe the characteristics of FDM signals.
- ▪ Describe a typical FDM multiplexer circuit.
- ▪ Describe the NE564 PLL circuit used as an FM modulator.
- ▪ Describe a typical FDM demultiplexer circuit.
- ▪ Describe the NE564 PLL circuit used as an FM demodulator.

5101-134-160 FDM Circuit Operation 322, 324, 325
- ▫ Observe the operation of a typical FDM multiplexer.
- ▫ Measure signals in a typical FDM multiplexer.
- ▫ Observe the operation of a typical FDM demultiplexer.
- ▫ Measure signals in a typical FDM demultiplexer.

5101-134-190 FDM Circuit Troubleshooting 322, 324, 325
- ▫ Determine if an FDM transmitter and receiver system is operating correctly.
- ▫ Identify the faulted component in a malfunctioning FDM transmitter and receiver system.

5101-138-920 Multiplexing Techniques Post-Test (Theory) . . . . . ---

LESSON ID/TITLE CARDS/KITS

MOD 46 - TELECOMMUNICATIONS

5102-312-130 Introduction to Communications Systems . . . . . ---
- ▪ Define the basic elements that make up communications systems.
- ▪ Describe common circuits and components that are contained in the elements of communications systems.
- ▪ Describe bandwidth as a limiting factor in communications systems.
- ▪ Describe noise as a limiting factor in communications systems.

5102-312-160 Telephone Systems . . . . . ---
- ▪ Define the construction of a basic telephone system.
- ▪ Describe the local area telephone network.
- ▪ Describe local area telephone calling.
- ▪ Describe the local loop.
- ▪ Describe the long distance telephone network.
- ▪ Describe a typical long distance hierarchy telephone system.

5102-312-190 Telephone Equipment 337
- ▪ Describe the operation of the mechanical telephone set.
- ▪ Describe the operation of the electronic telephone set.
- ▫ Observe the operation of an electronic telephone set and local loop.
- ▫ Measure signals in the local loop of an electronic telephone set.

5102-314-130 Fundamentals of Telecommunications . . . . . ---
- ▪ Define telecommunications.
- ▪ Identify a basic telecommunications system.
- ▪ Recognize the difference between wired and wireless.
- ▪ Describe the mission of the Federal Communications Commission (FCC).
- ▪ Identify the types of telecommunications systems.

5102-314-160 Telecommunications Careers . . . . . ---
- ▪ Identify the types of telecommunications careers.
- ▪ Identify the educational requirements of telecommunications careers.
- ▪ Describe the certification requirements of the telecommunications industry.

5102-314-190 History of Telecommunications . . . . . ---
- ▪ Identify innovators in the telecommunications industry.
- ▪ Describe a brief history of telecommunications.

5102-314-220 Special Interest Groups . . . . . ---
- ▪ Describe special interest groups in the telecommunications industry.

5102-314-250 Telecommunications Terminology . . . . . ---
- ▪ Recognize terms, jargon, and acronyms associated with the telecommunications industry.
- ▪ Define telecommunications terms using the appropriate jargon and acronyms.
- ▪ Identify symbols/flowcharts related to the telecommunications industry.

5102-314-310 Connection Links . . . . . ---
- ▪ Define a connection link, a physical link, and an atmospheric link.
- ▪ Understand the purpose of a connection link.
- ▪ Understand the effects of bandwidth, attenuation, and EMI.
- ▪ Define a metallic link.
- ▪ Define a non-metallic link.
- ▪ Identify a fiberoptic link.
- ▪ State the advantages of a fiberoptic link.
- ▪ Identify a radio link.
- ▪ Identify a microwave link.

LESSON ID/TITLE CARDS/KITS

MOD 46 - TELECOMMUNICATIONS (cont.)

5102-314-310 Connection Links (cont.)
- Identify a satellite link.

5102-314-340 Introduction to Network Switching . . . . . ---
- Define and identify the purpose of switching in a telecommunications network.
- Describe the four major methods and variations of switching in a telecommunications network.

5102-314-370 Broadcast Systems . . . . . ---
- Identify and discuss the different types of broadcast systems.
- Define and explain the role of broadcast systems in telecommunications.
- Explain the purpose and use of the Global Positioning System.

5102-314-400 Spread Spectrum Modulation . . . . . ---
- Identify the different techniques of spread spectrum modulation.
- Define and explain the purpose of spread spectrum modulation.
- Describe the PN sequence generation in spread spectrum systems.
- Describe the need and process for synchronization and preamble in spread spectrum systems.

5102-314-430 Cellular Telephony . . . . . ---
- Describe the theoretical and physical structures of a cellular telephone system and discuss the different multiplexing techniques used.
- Define cellular telephony and associated terminology.
- Explain the process of a cellular telephone call and state the difference between the original mobile telephone and cellular telephone.

5102-314-460 Information Systems . . . . . ---
- Describe LAN, WAN, and MAN computer networks.
- Identify the topologies and common components of the various types of networks.
- Define the term network and associated terminology.
- Understand the RF and IR wireless networks and explain the benefits they provide.
- Describe the use of spread spectrum in wireless networks.

5102-314-490 Satellite Systems . . . . . ---
- Describe satellite telecommunications systems including satellite types and capabilities.
- Understand the advantages and disadvantages of satellite radio.
- List multiple access techniques and common satellite electronic circuits.

MOD 47 - RF COMMUNICATIONS

5102-412-130 Introduction to Communications . . . . . ---
- Define a typical communications system.
- Understand common communications terminology.
- Understand the process of sound to audio frequency, audio frequency to sound conversion.

5102-412-160 Wave Propagation . . . . . ---
- Define wave propagation.
- Define terms used in describing wave propagation.
- Describe wave characteristics and their propagation paths.

5102-412-190 HF Fundamentals . . . . . ---
- Define the purpose of an HF system.
- Identify the HF frequency range.
- Define the different modes of operation of an HF system.

LESSON ID/TITLE CARDS/KITS

MOD 47 - RF COMMUNICATIONS (cont.)

5102-412-190 HF Fundamentals (cont.)
- ▪ Describe the HF system components.
- ▪ Describe a block diagram of an HF system.
- ▪ Understand HF Radio system circuit functions.
- ▪ Understand basic Fault Isolation of an HF system.

5102-414-130 Amplitude Modulation (AM) Receivers 438, 439, 440
- ▪ Define and understand amplitude modulation and heterodyning.
- ▪ Identify the major components of a typical AM receiver.
- ▪ Explain the major methods of tuning.
- ▫ Identify a modulated AM signal.
- ▫ Observe the effects of over modulation.
- ▫ Measure the IF of an AM receiver.
- ▫ Compare IF to a tuned RF signal.

5102-414-160 AM Receiver Analysis 438, 439, 440
- ▪ Identify AM receiver components.
- ▪ Describe AM receiver component functions.
- ▫ Examine the operation of AM receiver circuits.

5102-414-190 AM Receiver Troubleshooting 438, 439, 440
- ▫ Practice troubleshooting AM receivers.

5102-416-130 Frequency Modulation Receivers . . . . . ---
- ▪ Discuss the merits and deficiencies of FM vs. AM.
- ▪ Define terms associated with FM.
- ▪ Describe FM generation methods.
- ▪ Examine methods of tuning FM recievers.

5102-416-160 FM Receiver Analysis 441, 442, 443
- ▪ Perform schematic analysis of an FM Receiver.
- ▪ Analyze the FM Receiver circuits used in the FM Receiver.
- ▫ Perform a receiver alignment on an FM Receiver.

5102-416-190 FM Receiver Troubleshooting 441, 442, 443
- ▫ Practice troubleshooting FM Receivers.

5102-418-130 AM/CB Transceivers . . . . . ---
- ▪ Understand a transmitter block diagram.
- ▪ Identify high level modulation.
- ▪ Understand amplitude modulation and its power requirements.
- ▪ Understand VSWR and SWR.
- ▪ Understand a receiver block diagram.
- ▪ Describe a CB radio.

5102-418-160 AM/CB Transceiver Analysis 444, 445, 446
- ▪ Examine the major sections of an AM Transceiver.
- ▫ Observe a signal on an AM Transceiver.

5102-418-190 AM/CB Transceiver Troubleshooting 444, 445, 446
- ▫ Localize and isolate faults in an AM tranceiver.

5102-420-130 Single Sideband Transmitters/Receivers . . . . . ---
- ▪ Define and describe SSB Communications.
- ▪ Understand SSB generation (transmitters).
- ▪ Understand SSB receivers.

LESSON ID/TITLE CARDS/KITS

MOD 47 - RF COMMUNICATIONS (cont.)

5102-420-160 SSB Analysis 450, 451, 452, 453, 454, 455
- ▫ Examine the SSB transmitter and receiver circuits.
- ▫ Examine the SSB receiver circuits.

5102-420-190 SSB Troubleshooting 450, 451, 452, 453, 454, 455
- ▫ Understand the particulars of troubleshooting SSB equipment.
- ▫ Identify faults in a typical SSB system.

5102-422-130 Narrowband FM 456, 457
- ▪ Understand NBFM theory and analysis.
- ▫ Perform an alignment of the NBFM transmitter and receiver.

5102-422-160 Narrowband FM Troubleshooting 456, 457
- ▪ Understand the particulars of troubleshooting Narrowband FM equipment.
- ▫ Identify faults in a typical Narrowband FM system.

5102-424-130 Communications Troubleshooting . . . . . ---
- ▪ Perform an assessment of an FM Receiver.
- ▪ Localize a faulty receiver stage.
- ▪ Isolate faulty components.
- ▪ Reassess a receiver after repair.

MOD 48 - FIBEROPTIC CIRCUITS

5102-114-130 Introduction to Fiber Optics 251, 301, 302, 323
- ▪ Explain what light is and how it is produced.
- ▪ Identify the components of the visible spectrum and the optical spectrum.
- ▪ Describe the difference between reflection and refraction.
- ▪ Identify the law of reflection and Snell's law.
- ▪ Explain total internal reflection.
- ▪ Explain the operation of a fiberoptic system.
- ▪ Describe the three sections of a fiberoptic system.
- ▪ Identify some optical light sources and optical detectors.
- ▪ Describe the construction of a fiberoptic cable.
- ▪ Identify some of the advantages and disadvantages of fiberoptic systems.
- ▫ Become familiar with fiberoptic cables.
- ▫ Observe the operation of a fiberoptic system.

5102-114-160 Fiberoptic Components 251
- ▪ Define attenuation and bandwidth.
- ▪ Identify the primary causes of attenuation.
- ▪ Describe single mode and multimode optical fibers.
- ▪ Understand the numerical aperture rating.
- ▪ Identify some of the characteristics for optical sources.
- ▪ Describe the difference between homojunction and heterojunction LEDs.
- ▪ Describe the differences between LEDs and lasers.
- ▪ Identify some of the characteristics for optical detectors.
- ▪ Describe the differences between PIN photodiodes and APDs.
- ▫ Compare the operation of different optical sources to different optical detectors.
- ▫ Experimentally demonstrate certain limiting characteristics of some fiberoptic components.

5102-114-190 Signal Transmission 301, 302, 303, 305, 306, 322
- ▪ Describe the five areas of signal processing.

LESSON ID/TITLE CARDS/KITS

MOD 48 - FIBEROPTIC CIRCUITS (cont.)

5102-114-190 Signal Transmission (cont.)
- ▪ Explain AM, FM, PCM, and intensity modulation.
- ▪ Explain TDM, FDM, and WDM.
- ▪ Define SNR and BER.
- ▫ Construct and set up a fiberoptic system utilizing time division multiplexing.
- ▫ Demonstrate the operational characteristics of time division multiplexing.

5102-114-220 Fiberoptic Cable Connections 301, 302
- ▪ Explain losses due to the different types of misalignment and waveguide geometry.
- ▪ Describe the basic steps for splicing waveguides properly.
- ▪ Identify the six requirements for a good connector.
- ▫ Connectorize a fiberoptic cable properly.
- ▫ Determine the losses of adding a non-permanent mechanical splice to a fiberoptic cable.

5102-114-250 Fiberoptic System Troubleshooting 301, 302
- ▪ Identify a faulted fiberoptic system.
- ▪ Develop an organized troubleshooting strategy.
- ▪ Understand how to isolate a faulted section of a fiberoptic system.
- ▫ Demonstrate the steps involved in using a troubleshooting flowchart to properly troubleshoot a fiberoptic system .
- ▫ Examine the characteristics of a faulty transmission circuit, transmission medium, and receiver circuit.
- ▫ Troubleshoot random fiberoptic system faults.

5102-114-920 Fiber Optics Post-Test (Theory) . . . . . ---

MOD 49 - BASIC MICROWAVE

5121-112-130 Introduction to Microwaves . . . . . ---
- ▪ Provide a brief history of microwave inception and explain how microwave communications were initiated.
- ▪ Identify basic microwave principles and recognize the Radio Frequency spectrum.
- ▪ Identify microwave frequencies and factors affecting communications.
- ▪ Identify metric prefixes.
- ▪ Perform conversions between different metric prefixes.

5121-112-160 Introduction to Microwave Systems 307, 308
- ▪ Identify various stages in a basic microwave communications system.
- ▪ Describe the basic principle of multiplexing.
- ▪ Describe the purpose of microwave repeater stations.
- ▪ Identify basic microwave components and devices.
- ▫ Observe the effects of blocked microwave transmission signals and misaligned microwave antennas.
- ▫ Become familiar with the Nida Model 330 Microwave Trainer.

5121-112-190 Microwave Transmitters 307, 308
- ▪ Describe the operation of typical microwave transmitters.
- ▪ Describe the operation of the transmitter in the Nida Model 330 Microwave Trainer.
- ▫ Observe and trace signals through a basic microwave transmitter.

5121-112-220 Microwave Receivers 307, 308
- ▪ Describe the operation of a typical microwave receiver.
- ▪ Describe the operation of the receiver in the Nida Model 330 Microwave Trainer.

LESSON ID/TITLE — CARDS/KITS

MOD 49 - BASIC MICROWAVE (cont.)

5121-112-220 Microwave Receivers (cont.)
- ▫ Observe the trace signals through a basic microwave receiver.

5121-112-250 Waveguide Theory . . . . . ---
- ▪ Describe a waveguide and explain the advantages and disadvantages of waveguides over other means of transferring RF energy.
- ▪ Explain how waveguides are developed from parallel to wire transmission lines.
- ▪ Describe waveguide plumbing.

5121-112-280 Antennas 307, 308
- ▪ Describe the basic construction and theory of operation of various types of antennas.
- ▫ Verify that microwave signals can be reflected.

5121-112-310 Cavity Resonators and Tube Microwave Devices . . . . . ---
- ▪ Describe the purpose of cavity resonators.
- ▪ Describe the basic theory and operation of cavity resonators.
- ▪ Describe the basic principle of microwave tubes and their limitations.
- ▪ Describe the basic theory and operation of Klystrons and Magnetrons.

5121-112-340 Semiconductor Microwave Devices . . . . . ---
- ▪ Describe the limitations of Bipolar and Field Effect Transistors at microwave frequencies.
- ▪ Describe methods to minimize limitations in Bipolar and Field Effect Transistors at microwave frequencies.
- ▪ Describe the basic theory of operation of Varactor Diodes, Tunnel Diodes, Gunn Diodes and DROs.

MOD 50 - BASIC RADAR SYSTEMS

5061-212-130 Introduction to Radar . . . . . ---
- ▪ Define terms, abbreviations, and symbols used in conjunction with radar principles.
- ▪ Convert decibel and power ratio into standardized reference power (dBm).
- ▪ Describe the composition of a basic radar system.
- ▪ Identify the blocks of a basic radar system.
- ▪ Define abbreviations, terms, symbols, and characteristics used in conjunction with radar systems.
- ▪ State the purpose and use of the surface search, air search, and targeting radar systems.
- ▪ Explain the basic operation of a pulse, continuous wave (CW), and Doppler radar system.
- ▪ Describe a block diagram of a pulse radar system.
- ▪ Understand pulse radar circuit functions.
- ▪ Describe basic radar antennas.

5061-212-160 Basic Radar Operation 231
- ▫ Examine a typical radar timing circuit.
- ▫ Examine both a sweep and video amplifier.
- ▫ Examine typical radar characteristics.

5061-212-190 Radar Transmitters and Receivers . . . . . ---
- ▪ Define radar transmitter abbreviations, terms, and symbols.
- ▪ Describe the function, operational characteristics, and major subsections of a typical radar transmitter.
- ▪ Define radar receiver abbreviations, terms, and symbols.
- ▪ Describe the function, operational characteristics, and major subsections of a typical radar receiver.

LESSON ID/TITLE CARDS/KITS

MOD 50 - BASIC RADAR SYSTEMS (cont.)

5061-212-220 Transmission Lines . . . . . ---
- Identify transmission line operating characteristics.
- Identify the different types of transmission lines.

5061-212-250 Waveguide Theory . . . . . ---
- Describe a waveguide and explain the advantages and disadvantages of waveguides over other means of transferring RF energy.
- Explain how waveguides are developed from parallel transmission lines.
- Describe waveguide impedance matching terminations.
- Describe waveguide components.
- Describe waveguide plumbing.

5061-212-280 Antennas . . . . . ---
- Understand antenna characteristics.
- Explain the propagation of energy in antennas.

5061-212-310 Cavity Resonators and Tube Microwave Devices . . . . . ---
- Describe the purpose of cavity resonators.
- Describe the basic theory and operation of cavity resonators.
- Describe the basic principle of microwave tubes and their limitations.
- Describe the basic theory and operation of klystrons and magnetrons.

5061-212-340 Semiconductor Microwave Devices . . . . . ---
- Describe the limitations of bipolar and field effect transistors at microwave frequencies.
- Describe methods to minimize limitations in bipolar and field effect transistors at microwave frequencies.
- Describe the basic theory of operation of varactor diodes, tunnel diodes, gunn diodes, and DROs.

5061-212-370 Electromagnetic Compatibility and Countermeasures . . . . . ---
- Define terms, abbreviations, and symbols associated with electromagnetic compatibility.
- Describe the function and operational characteristics of electromagnetic compatibility (EMC), electronic countermeasures (ECM), and electronic counter-countermeasures (ECCM).

5061-212-400 Radar Auxiliary Systems . . . . . ---
- Define terms, abbreviations, and symbols used with radar dry air systems.
- Describe the function and operational characteristics of radar dry air systems.
- Define terms, abbreviations, and symbols used with radar cooling systems.
- Describe the function and operational characteristics of radar cooling systems.

5061-212-920 Basic Radar Systems Post-Test (Theory) . . . . . ---

MOD 51 - INTRODUCTION TO AVIATION MAINTENANCE TECHNOLOGY

7121-114-190 Introduction to Aviation Technology . . . . . ---
- Identify the types of careers that support the aviation industry.
- Describe a brief history of aviation maintenance.
- Describe the certification process of the Aviation Maintenance Technician.
- Describe the certification process of the Avionics Technician.

7121-114-250 General Aircraft Principles . . . . . ---
- Describe the major sections of a typical aircraft.
- Define and describe the physics principles that affect thrust, drag, lift, and gravity.
- Define and describe the three axes of flight.
- Define and describe the primary flight controls of an aircraft.

LESSON ID/TITLE CARDS/KITS

MOD 51 - INTRODUCTION TO AVIATION MAINTENANCE TECHNOLOGY (cont.)

7121-114-250 General Aircraft Principles (cont.)
- Define and describe the secondary flight controls of an aircraft.
- Define and describe the auxiliary flight controls of an aircraft.

7121-114-310 Aircraft Structures . . . . . ---
- Describe the types of materials used in aircraft construction.
- Describe the advantages and disadvantages of using metals in aircraft construction.
- Describe the advantages and disadvantages of using composites in aircraft construction.
- Describe fuselage shapes and construction, and their effect on aircraft flight.
- Describe wing shapes and construction, and their effect on aircraft flight.
- Describe tail shapes and construction, and their effect on aircraft flight.

7121-114-370 Aircraft Power Plants . . . . . ---
- Describe the principles and operation of internal combustion engines.
- Describe the principles and operation of jet propulsion engines.
- Understand the fundamentals of propellers.

7121-114-490 FOE (Foreign Object Elimination) . . . . . ---
- Define terminology and acronyms associated with FOD.
- Identify the types of FOD.
- Describe the potential damage or harm to aircraft and humans by foreign objects found in the aviation community.
- Identify good housekeeping practices to reduce and eliminate FOD.
- Define control methods for eliminating FOD in the hangar and ramp areas.
- Describe the methods of protecting parts from FOD.
- Define the components of an FOE (Foreign Object Elimination) program.
- Describe the process followed when tools or material are missing during aircraft maintenance.
- Detail a brief history of Nida Corporation.
- Describe the various aviation technical training programs that Nida offers.

7121-114-920 Introduction to Aviation Maintenance Technology Post-Test (Theory) . . . . . ---

MOD 52 - AIRCRAFT PUBLICATIONS

7121-126-130 Aircraft Regulatory Publications . . . . . ---
- Identify the FAR Parts that apply to the Airframe and Power Plant Technician.
- Identify the FAR Part titles that apply to the Airframe and Power Plant Technician.
- Define selected Part 1 abbreviations.
- Describe the purpose of FAA Regulatory Publications.
- Identify the correct publication to locate aircraft maintenance requirements.

7121-126-190 Aircraft Drawings . . . . . ---
- Identify types of aircraft drawings.
- Understand symbols, markings, and lines on aircraft drawings.
- Describe the ways information is presented in an aircraft drawing.
- Prepare drawing in accordance with instructor provided specifications.

7121-126-250 Aircraft Technical Publications . . . . . ---
- Identify technical information using the Air Transport Association Specification 100 (ATA Spec 100) numbering system.
- Describe the purpose and identify the information in the Aircraft Maintenance, Overhaul, Structural Repair, Service, and Component manuals.

LESSON ID/TITLE CARDS/KITS

MOD 52 - AIRCRAFT PUBLICATIONS (cont.)

7121-126-250 Aircraft Technical Publications (cont.)
- Identify the purpose of Service Bulletins and describe their use.
- Describe the purpose of the Illustrated Parts Catalog/Breakdown Manual.
- Identify the layout, structure, and sections of the Illustrated Parts Catalog/Breakdown Manual.
- Utilizing aircraft technical publications, identify the proper procedures for given tasks.
- Utilizing an aircraft IPC/IPB, locate information on assemblies, subassemblies, and parts.

7121-126-920 Aircraft Publications Post-Test (Theory) . . . . . ---

MOD 53 - LINE MAINTENANCE

7121-130-130 Flight Line Safety . . . . . ---
- Describe the personal protection required when working on an aircraft flight line.
- Describe and identify flight line ground support equipment.
- Demonstrate the procedures and safety precautions on an aircraft flight line.
- Identify the danger zones associated with aircraft movement and operations.

7121-130-190 Flight Line Fire Protection . . . . . ---
- Define the elements of fire.
- Understand fire classifications.
- Identify the correct fire extinguishing agent for a given fire classification.
- Identify and describe the fire-prone areas and fire fighting areas on an aircraft.
- Describe the duties of an aircraft fireguard.
- Understand how to use a portable fire extinguisher.

7121-130-250 Aircraft Ground Operations . . . . . ---
- Understand how aircraft ground operations are performed.
- Explain the proper procedures for towing and taxiing an aircraft.
- Identify the types of aircraft tie-down equipment.
- Identify the proper tie-down method for various weather conditions.
- Describe the procedures for de-icing an aircraft.

7121-130-920 Line Maintenance Post-Test (Theory) . . . . . ---

MOD 54 - AIRCRAFT WIRING

7121-314-700 Aircraft Wires and Connectors . . . . . ---
- Identify the common types of wire and cable and their uses.
- Identify each element of a wire identification number.
- Describe the purpose of wire bundle lacing, spot tying, grommets, Adel clamps, and wrapping.
- Identify the types and purpose of aircraft wiring splices, terminal lugs, and connectors.
- Identify the types of tools utilized in maintaining aircraft wiring connections.

7121-314-730 Aircraft Wire Repair and Troubleshooting 746, 747, 748
- Identify parts of a wire harness assembly.
- Understand how a wire harness assembly is constructed using screw-on and twist and lock connectors.
- Identify tools required to build a wire and connector harness assembly that has screw-on and twist and lock connectors.
- Understand how wire and harness assembly tools are used.
- Build and install a simple aircraft wiring system.

LESSON ID/TITLE CARDS/KITS

MOD 54 - AIRCRAFT WIRING (cont.)

7121-314-730 Aircraft Wire Repair and Troubleshooting (cont.)
- ▫ Analyze a simple aircraft wiring system.
- ▫ Identify faults in a wire and connector assembly.
- ▫ Repair a fault in a wire and connector assembly.
- ▫ Modify the simple aircraft wiring system according to a sample FAA Airworthiness Directive and Manufacturer's Service Bulletin.
- ▫ Remove the wiring and connectors from the Cockpit Wiring circuit card.
- ▫ Disassemble the wiring harness on the Aircraft Wiring circuit card.
- ▫ Remove the wire harness from the Bulkhead Harness circuit card.
- ▫ Restore circuit card soldered wire connections, plugs, and jacks to reusable conditions.

7121-314-920 Aircraft Wiring Post-Test (Theory) . . . . . ---

MOD 55 - AIRCRAFT POWER

7121-318-130 Introduction to Aircraft Systems Troubleshooting 739, 740, 741, 742
- ▪ Describe the types of aircraft systems and their purpose.
- ▪ Describe the steps in a typical troubleshooting process.
- ▫ Use the basic troubleshooting process to identify probable faults in a generic operational circuit card system.

7121-318-190 Aircraft Batteries . . . . . ---
- ▪ Explain the theory of chemical batteries.
- ▪ Identify types and construction of aircraft batteries.
- ▪ Identify battery shop safety features and precautions when servicing various types of batteries.
- ▪ Explain the process of servicing a lead-acid battery.
- ▪ Explain the process of servicing a nickel-cadmium battery.
- ▪ Service an aircraft battery in accordance with published procedures.

7121-318-250 Aircraft DC Generation Systems 180, 734, 735, 736
- ▪ Identify the types of DC generation devices.
- ▪ Describe the operation of a DC generator, DC alternator, turbine engine starter-generator, converter, and transformer rectifier.
- ▪ Describe the purpose and operation of current limiters, DC regulators, reverse current relays (RCRs), generator control units (GCUs), and alternator control units (ACUs).
- ▪ Identify common problems encountered in a DC generation system and their typical fixes.
- ▪ Describe the operation of a twin-engine alternator system.
- ▪ Describe the purpose and operation of alternator load balancing.
- ▫ Balance an alternator paralleling system.

7121-318-310 Aircraft AC Generation Systems . . . . . ---
- ▪ Identify the types of AC generation devices.
- ▪ Describe the operation of an AC generator/inverter.
- ▪ Describe the operation of an AC generation system.
- ▪ Identify common inspection and maintenance practices of an AC generation system.
- ▪ Given AC generation fault scenarios, use a schematic to identify the probable cause.

7121-318-370 Basic Aircraft Power Distribution Systems 734, 735
- ▪ Describe the operation of a basic power distribution system.
- ▪ Identify the basic requirements for a power distribution system.
- ▪ Identify the various components of basic power distribution systems.

LESSON ID/TITLE CARDS/KITS

MOD 55 - AIRCRAFT POWER (cont.)

7121-318-370 Basic Aircraft Power Distribution Systems (cont.)
- ▫ Observe the operation of a basic power distribution system.
- ▫ Observe faults in a basic power distribution system.

7121-318-430 Multi-Engine Aircraft Power Distribution Systems 735, 736
- ▪ Describe the operation of a split-bus power distribution system.
- ▪ Identify the components of a split-bus power distribution system.
- ▪ Describe the operation of a parallel bus power distribution system.
- ▪ Identify the components of a parallel bus power distribution system.
- ▫ Observe the operation of a split-bus distribution system.
- ▫ Identify faults in a basic split-bus distribution system.

7121-318-920 Aircraft Power Post-Test (Theory) . . . . . ---

MOD 56 - AIRCRAFT AIRFRAME SYSTEMS

7121-514-190 Aircraft Lighting Systems 749, 750, 751, 752
- ▪ Identify the types of light bulbs used on aircraft.
- ▪ Given a list of light bulb characteristics, identify the correct bulb for a given condition.
- ▪ Describe the configuration, purpose, and operation of typical aircraft interior and emergency lighting system circuits.
- ▪ Describe exterior navigation lighting locations and configuration.
- ▪ Identify typical exterior lighting used for landing, taxiing, and safety.
- ▫ Observe and troubleshoot an incandescent lighting circuit.
- ▫ Observe and troubleshoot a strobe lighting system.
- ▫ Observe and troubleshoot malfunctions in interior lighting and emergency exit systems.

7121-514-250 Aircraft Ice and Rain Protection Systems . . . . . ---
- ▪ Describe the dangers of aircraft icing.
- ▪ Describe the types and operation of aircraft ice detection systems.
- ▪ Identify the components and function of the pitot-static ice protection system.
- ▪ Identify the types and operation of aircraft anti-ice systems.
- ▪ Identify the types and operation of aircraft de-icing systems.
- ▪ Describe the types and purpose of the aircraft windshield wiper/washer systems.
- ▪ Understand the operation of the aircraft windshield wiper/washer systems.
- ▪ Understand maintenance precautions for the windshield wiper/washer systems.

7121-514-310 Environmental Control Systems 731, 732, 733, 733E
- ▪ Describe a typical pneumatic system.
- ▪ Describe a typical air conditioning system.
- ▪ Describe a typical pressure control system.
- ▫ Observe the operation of a typical thermostat and trim valve in an air conditioning system.
- ▫ Isolate a fault in a typical thermostat and trim valve of an air conditioning system.

7121-514-370 Landing Gear Systems 743, 744, 745
- ▪ Identify the components associated with a landing gear shock strut assembly.
- ▪ Describe the function of each landing gear component.
- ▪ Describe the operation of the landing gear shock strut.
- ▪ Describe the flow through the landing gear hydraulic system.
- ▪ Describe the function of the landing gear electrical system.
- ▪ Identify typical landing gear hydraulic and electrical malfunctions.
- ▫ Observe the normal operation of a typical landing gear system.

LESSON ID/TITLE CARDS/KITS

MOD 56 - AIRCRAFT AIRFRAME SYSTEMS (cont.)

7121-514-370 Landing Gear Systems (cont.)
- ▫ Troubleshoot and isolate the cause of landing gear system faults.

7121-514-430 Aircraft Braking Systems . . . . . ---
- ▪ Define the types of wheel assemblies.
- ▪ Identify the key components of an aircraft wheel assembly.
- ▪ Identify the parts of an aircraft tire and describe their purpose.
- ▪ Describe the safety precautions associated with aircraft wheel assemblies.
- ▪ Describe tire inspection and maintenance processes.
- ▪ Define the distinguishing properties of expander tube, independent, power boost brake, and power control brake systems.
- ▪ Identify the components of expander tube, independent, power boost brake, and power control brake systems.
- ▪ Describe the safety precautions associated with brake systems.
- ▪ Describe the brake system inspection and maintenance process.
- ▪ Describe the purpose of the Anti-Skid System.
- ▪ Given a list of anti-skid components, identify and describe the function of each component.
- ▪ Given a schematic of a generic anti-skid system, describe the corrective action for various system malfunctions.

7121-514-490 Fire Warning and Extinguishing Systems 738
- ▪ Identify different types of fire warning systems.
- ▪ Explain the basic operation of each type of system.
- ▪ Describe the different types of fire extinguishing agents.
- ▪ Explain the basic operation of the fire extinguishing system.
- ▫ Identify a normal operating fire warning system.
- ▫ Identify a faulty operating fire warning system.

7121-514-550 Aircraft Fuel Systems . . . . . ---
- ▪ Describe the characteristics and properties of aviation fuels.
- ▪ Identify the effects of fuel contamination.
- ▪ Describe the gravity type fuel system.
- ▪ Describe the pump type fuel system.
- ▪ Describe the operational characteristics of the fuel system components.
- ▪ Describe the operation of a carburetor.
- ▪ Describe the operation of fuel injection.

7121-518-190 Aircraft Ignition Systems . . . . . ---
- ▪ Identify the types of ignition systems.
- ▪ Describe the principles of spark discharge and coil ignition systems.
- ▪ Describe the types of magneto ignition systems.
- ▪ Describe the principles of gas turbine ignition systems.
- ▪ Describe the principles of operation of ignition systems.
- ▪ State the advantages and disadvantages of high and low tension magneto systems.

MOD 57 - AIRCRAFT INSTRUMENT SYSTEMS

7121-714-130 Introduction to Aircraft Instruments . . . . . ---
- ▪ Identify the classifications of aircraft instruments.
- ▪ Define and describe basic aircraft instruments.
- ▪ Describe the various operating principles of aircraft instruments.

LESSON ID/TITLE CARDS/KITS

MOD 57 - AIRCRAFT INSTRUMENT SYSTEMS (cont.)

7121-714-190 Tachometer, Torque, and Position-Indicating Systems ..... ---
- ▪ Recognize the operating principles and characteristics of the tachometer and position-indicating systems.
- ▪ Recognize the operating principles and characteristics of torque systems.
- ▪ Identify the basic procedures used in maintaining aircraft instruments.

7121-714-250 Temperature and Fuel Flow Indicating Systems 189, 190
- ▪ Identify the types and describe the function of the Exhaust Gas Temperature (EGT), Cylinder Head Temperature (CHT), and Carburetor Air Temperature (CAT) sensing systems instruments.
- ▪ Identify the types and describe the function of fuel flow indicating systems instruments.
- ▫ Identify the principles of temperature transducers.
- ▫ Analyze the operation of solid-state temperature transducers.

7121-714-310 Pressure Sensing and Chip Detection Systems 241, 242
- ▪ Identify the types and describe the function of pressure sensing and chip detection indicating systems instruments.
- ▫ Identify the principles of pressure transducers.
- ▫ Analyze the operation of solid-state pressure transducers.

7121-714-370 Aircraft Electronic Flight Instrument Systems ..... ---
- ▪ Describe the systems and components of the aircraft monitoring and alerting system.
- ▪ Describe the different types of aircraft built-in fault and maintenance test equipment.

7121-714-430 Aircraft Master Warning and Annunciator Systems 735, 737
- ▪ Describe the operation of the master warning and annunciator system.
- ▪ Identify annunciator system applications.
- ▫ Observe master warning and annunciator system operation.
- ▫ Observe normal system operation.
- ▫ Identify faulty system operation.

7121-714-920 Aircraft Instrument Systems Post-Test (Theory) ..... ---

MOD 58 - AIRCRAFT COMMUNICATIONS SYSTEMS

7121-722-130 Introduction to Aircraft Communications ..... ---
- ▪ Define a typical communications system.
- ▪ Identify the types of radios and their uses.
- ▪ Identify and describe aircraft internal communications systems.
- ▪ Identify common radio communications failures and describe typical repairs for each failure.
- ▪ Identify the letters of the phonetic alphabet.
- ▪ Describe the procedures and regulations for transmitting a radio communications check.

7121-722-190 Aircraft Communications Systems ..... ---
- ▪ Explore high frequency radio wave propagation.
- ▪ Categorize frequency range applications.

7121-722-250 Aircraft Antenna Systems ..... ---
- ▪ Understand antenna characteristics.
- ▪ Explain the propagation of electromagnetic energy in antennas.
- ▪ Identify the correct antenna for associated aircraft COM/NAV system.
- ▪ Describe the general location of each type of aircraft antenna.

7121-722-920 Aircraft Communication Systems Post-Test (Theory) ..... ---

LESSON ID/TITLE — CARDS/KITS

MOD 59 - AIRCRAFT NAVIGATION SYSTEMS

7121-726-130 Introduction to Aircraft Navigation . . . . . ---
- Define the purpose of an air navigation system.
- Describe the types of air navigation systems.
- Define the terms associated with air navigation.
- Plot latitude and longitude positions on an air navigation chart.
- Identify types of air navigation information display indicators.
- Describe the purpose of ADI, BDI, HSI, and MFD air navigation indicators.
- Identify and describe the information displayed by the ADI, BDI, HSI, and MFD air navigation indicator.

7121-726-190 Short Range Aircraft Navigation Systems . . . . . ---
- Describe the process of “swinging” a magnetic or standby compass.
- Identify the components of the primary compass system.
- Describe the operation of a primary compass system.
- Identify causes of primary compass system errors.
- Describe the purpose, components, and operation of the NDB, ADF, VOR, DME, TACAN, VORTAC, and RNAV systems.
- Define the errors associated with using the ADF system for navigation.
- Describe the system components and operation of the Instrument Landing System (ILS).
- Describe the purpose, components, and operation of approach and landing navigation systems (Localizer, Glideslope, Marker Beacon).
- Describe the advantages and general operating principles of the Microwave Landing System (MLS) and Global Navigation Satellite System (GNSS) Landing System (GLS).

7121-726-250 Long Range Aircraft Navigation Systems . . . . . ---
- Describe the process of Global Positioning System (GPS) navigation.
- Identify the components of a GPS system and describe their operation.
- Describe the process of ADS-B navigation.
- Identify the components of an ADS-B system and describe their purpose.
- Describe the purpose and operation of the Doppler System.
- Describe the process of Heading Reference System (HRS) navigation.
- Identify the components of an HRS system and describe their operation.
- Describe the process of Inertial Navigation System (INS).
- Identify the components of an INS system and describe their purpose.

7121-726-310 Aircraft Collision Avoidance and Detection Systems . . . . . ---
- Describe the process of the aircraft collision avoidance program.
- Identify the components of the system and describe their operation.
- Describe the process of sensor technology.
- Identify the different types of sensors used in collision avoidance systems.

7121-726-920 Aircraft Navigation Systems Post-Test (Theory) . . . . . ---

MOD 60 - AVIONICS DATA COMMUNICATIONS

5161-118-130 Introduction to Data Communications 265, 266, 284
- Define terminology commonly used in conjunction with data communications systems.
- Identify systems and instrumentation including fax, modems, and computers that use data communications.
- Identify basic operating characteristics involved in data communications.
- Identify the operational characteristics of protocol.

LESSON ID/TITLE CARDS/KITS

MOD 60 - AVIONICS DATA COMMUNICATIONS (cont.)

5161-118-130 Introduction to Data Communications (cont.)
- ▪ Define protocol terminology to include bit, byte, start, parity, stop, baud, and frame.
- ▪ Describe how data communications systems use protocol to transfer data.
- ▪ Describe the relationship of protocol and serial/parallel transmission and reception using the International Standard Organization (ISO) reference model.
- ▫ Examine pulse characteristics like: period, pulse duration, duty cycle, amplitude, rise and fall time, and baseline voltage.
- ▫ Examine the effects of synchronization and a protocol mismatch of transmitter data.
- ▫ Observe serial data communications between sender and receiver.
- ▫ Identify the start bits, data bits, parity bit, and stop bits.

5161-118-160 RS-232-C Line Interface 232
- ▪ Identify RS-232-C electrical, mechanical, and functional characteristics as they relate to protocol.
- ▪ Identify the RS-232-C schematic pinout.
- ▪ Describe the function of the UART and USART.
- ▫ Measure RS-232-C line interface voltages while data is being transferred.
- ▫ Measure RS-232-C Line interface voltages while data is being received.
- ▫ Isolate malfunctions in an operational RS-232-C communications system.

5161-118-190 RS-485 Line Interface 232
- ▪ Identify RS-485 electrical characteristics.
- ▪ Describe signal conditioning methods used by RS-485 line driver circuits when transmitting and receiving.
- ▫ Measure RS-485 line interface voltages while data is being transferred.
- ▫ Isolate malfunctions in an operational RS-485 Communication System.

5161-118-220 Introduction to Bus Systems 267, 268, 284
- ▪ Identify the basic parts of a bus system.
- ▪ Describe the purpose of each part of the bus system.
- ▪ Define terminology used in conjunction with bus system protocol.
- ▪ Describe the operational characteristics of a basic bus system.
- ▪ Describe the operational characteristics of tri-state devices.
- ▫ Measure basic bus system signals.
- ▫ Measure the output of a tri-state device.

5161-118-250 IEEE 488 Data Bus . . . . . ---
- ▪ Identify 4 basic operations performed by the 4041 controller.
- ▪ Define program development, instrument control, data processing and display storage.
- ▪ Describe and interpret different message formats.

5161-118-280 ARINC 429 Data Bus . . . . . ---
- ▪ Identify basic principles of operation related to the ARINC 429 data bus system specifications.
- ▪ Describe the ARINC 429 Mark 33 Digital Information Transfer System (DITS).
- ▪ Describe and interpret different message formats.
- ▪ Describe and interpret different word formats.

5161-118-310 ARINC 629 Data Bus . . . . . ---
- ▪ Describe the different components associated with the ARINC 629 data bus system.
- ▪ Identify basic principles of operation related to the ARINC 629 data bus system specifications.
- ▪ Describe and interpret different data formats.

LESSON ID/TITLE CARDS/KITS

MOD 60 - AVIONICS DATA COMMUNICATIONS (cont.)

5161-118-310 ARINC 629 Data Bus (cont.)
- Describe and interpret different word formats.

5161-118-920 Data Communications Post-Test (Theory) . . . . . ---

MOD 61 - INTRODUCTION TO VEHICLE TECHNOLOGY

7021-112-130 Introduction to the Automobile . . . . . ---
- Understand the history of the automobile.
- Identify 9 of the many automobile systems.
- Identify careers associated with the automobile.

7021-112-160 Electrical Systems . . . . . ---
- Identify an automobile battery.
- Identify devices of the automobile.
- Understand how the devices get electrical energy from the battery.
- Understand that a computer can control some systems of the automobile.

7021-112-190 Charging and Ignition Systems . . . . . ---
- Understand how the alternator works to recharge the battery.
- Understand how the ignition coil works to ignite the fuel in the engine.

7021-112-220 Fuel Systems . . . . . ---
- Understand how a carburetor functions.
- Understand how fuel injection functions.
- Understand how a turbocharger functions.

7021-112-250 Engines . . . . . ---
- Identify basic engine parts.
- Understand how the engine functions.
- Understand how engines are classified.

7021-112-280 Cooling Systems . . . . . ---
- Identify the parts of the automobile's cooling system.
- Understand the function of the cooling system.

7021-112-310 Hydraulic Systems . . . . . ---
- Understand the automobile's braking system.
- Understand the automobile's power steering system.

7021-112-340 Air Conditioning and Heating Systems . . . . . ---
- Identify the major parts of the air conditioning system.
- Understand how the air conditioning system functions.
- Identify the parts of the heating system.
- Understand how the heating system functions.

7021-112-370 Drive Train and Suspension . . . . . ---
- Identify the parts of the drive train.
- Understand the function of the drive train.
- Identify the parts of the suspension.
- Understand the function of the suspension.

7021-112-400 Body Design . . . . . ---
- Identify the automobile body parts.
- Understand the function of the automobile body parts.
- Identify the different options of an automobile.
- Understand the capabilities of each option.

LESSON ID/TITLE CARDS/KITS

MOD 61 - INTRODUCTION TO VEHICLE TECHNOLOGY (cont.)

7021-112-920 Introduction to Vehicle Technology Post-Test (Theory) . . . . . ---

MOD 62 - INTRODUCTION TO AUTOMOTIVE ELECTRICITY

7021-212-130 Automotive Safety . . . . . ---
- Identify safety habits associated with electrical and other equipment.
- Identify hazards associated with the automobile.

7021-212-160 Metric Notation . . . . . ---
- Convert decimal numbers to powers of ten and vice versa.
- Convert decimal numbers to metric prefixes and vice versa.
- Add, subtract, multiply, and divide powers of ten.
- Add, subtract, multiply, and divide metric prefixes.

7021-212-190 Voltage, Current, and Resistance . . . . . ---
- Describe an atom and its structure.
- Define electric charge as it relates to electrons and protons.
- Describe the law of electrostatic forces.
- Define voltage and the volt as a unit of voltage.
- Define the relationship between voltage and potential difference.
- Define current and the ampere as the unit of current.
- Describe a conductor and the behavior of electrons within a conductor.
- Describe an insulator and the behavior of electrons within an insulator.
- Identify the purpose of a resistor.
- Identify the unit of resistance as the ohm.

7021-212-220 Switches and Protective Devices . . . . . ---
- Identify the purpose of a switch.
- Identify switch schematic symbols.
- Describe single and double pole.
- Describe single and double throw.
- Identify the purpose of protection devices.
- Identify a fuse and a circuit breaker.
- Identify schematic symbols for fuses and circuit breakers.
- Identify a fusible link.

7021-212-920 Introduction to Automotive Electricity Post-Test (Theory) . . . . . ---

MOD 63 - AUTOMOTIVE TEST EQUIPMENT

7021-214-130 Introduction to Multimeters . . . . . ---
- Describe the purpose of a multimeter.
- Identify the quantities measured by multimeters.
- Identify two types of multimeter displays.
- Describe the four functional sections of the multimeter.
- Describe the purpose of each functional section.

7021-214-160 Multimeter Use 701
- Understand the operation of a digital multimeter.
- Understand the steps to make a proper measurement using a digital multimeter.

7021-214-190 Voltage Measurements 701
- Describe how to set up a multimeter to measure voltage.
- Describe how to read a multimeter's display when measuring voltage.

LESSON ID/TITLE CARDS/KITS

MOD 63 - AUTOMOTIVE TEST EQUIPMENT (cont.)

7021-214-190 Voltage Measurements (cont.)
- ▪ Identify the precautions to observe when making voltage measurements.
- ▫ Perform voltage measurements using a digital multimeter.

7021-214-220 Current Measurements 701
- ▪ Describe how to set up a multimeter to measure current.
- ▪ Describe how to read a multimeter's display when measuring current.
- ▪ Identify the precautions to observe when making current measurements.
- ▫ Perform current measurements using a digital multimeter.

7021-214-250 Resistance Measurements 708
- ▪ Describe how to set up a multimeter to measure resistance.
- ▪ Describe how to read a multimeter's display when measuring resistance.
- ▪ Describe the precautions to observe when making resistance measurements.
- ▪ Define power rating.
- ▪ Define tolerance.
- ▪ Identify number/letter codes.
- ▫ Perform resistance measurements.

7021-214-280 Introduction to the Oscilloscope 707, 708
- ▪ Describe the purpose of an oscilloscope.
- ▪ Identify the quantities measured by an oscilloscope.
- ▪ Describe single trace and dual trace oscilloscopes.
- ▪ Identify the four major functional sections.
- ▪ Describe the purpose of each control and switch.
- ▫ Set up an oscilloscope for normal operation.
- ▫ Use an oscilloscope to analyze a waveform.
- ▫ Measure voltage using an oscilloscope.

7021-214-920 Automotive Test Equipment Post-Test (Theory) . . . . . ---

MOD 64 - BASIC ELECTRICAL DC AND AC

7021-216-130 Ohm's Law and Power 701
- ▪ Define Ohm's Law and describe how voltage, current, and resistance are related.
- ▪ Define power and describe how voltage, current, and Ohm's Law are related to power.
- ▫ Prove the Ohm's Law relationship of voltage, current, and resistance.

7021-216-160 Series Circuits and the Automobile 702
- ▪ Identify a simple series circuit.
- ▪ Understand basic principles of a series circuit.
- ▪ Verify that Ohm's Law applies to series circuits.
- ▫ Observe a working series circuit.
- ▫ Verify basic principles of a series circuit.

7021-216-190 Parallel Circuits 703
- ▪ Identify a parallel circuit.
- ▪ Recognize that the applied voltage is the same across each branch.
- ▪ Calculate current in each branch of a parallel circuit.
- ▪ Calculate total current from the sum of the individual branches of a parallel circuit.
- ▪ Calculate total resistance in a parallel circuit.
- ▫ Measure the applied voltage across each branch in a parallel circuit.
- ▫ Measure resistance in a parallel circuit.

LESSON ID/TITLE CARDS/KITS

MOD 64 - BASIC ELECTRICAL DC AND AC (cont.)

7021-216-190 Parallel Circuits (cont.)
- ▫ Measure current in a parallel circuit.

7021-216-220 Series-Parallel Circuits 704
- ▪ Identify a series-parallel circuit.
- ▪ Calculate total resistance in a series-parallel circuit.
- ▪ Calculate current in a series-parallel circuit.
- ▪ Calculate voltage drops in a series-parallel circuit.
- ▫ Measure resistance values in a series-parallel circuit.
- ▫ Measure current values in a series-parallel circuit.
- ▫ Measure voltage drops in a series-parallel circuit.

7021-216-250 Voltage Divider Circuits 705
- ▪ Identify a voltage divider circuit.
- ▪ Identify a voltage divider as loaded or unloaded.
- ▪ Calculate loaded and unloaded voltage divider current, voltage, and resistance values.
- ▪ Calculate % regulation for a voltage divider circuit.
- ▫ Identify and measure various characteristics of a voltage divider circuit.

7021-216-280 Relay Operation 706
- ▪ Describe the purpose and type of relays.
- ▪ Describe basic relay construction and operation.
- ▪ Describe the latched and time delay relay.
- ▫ Observe basic relay operation.
- ▫ Observe characteristics of a basic relay circuit.

7021-216-310 Alternating Current . . . . . ---
- ▪ Define alternating current.
- ▪ Identify an AC sine wave.
- ▪ Define frequency and cycle.
- ▪ Describe hertz.
- ▪ Determine the wavelength of a sine wave.
- ▪ Determine the period of a sine wave.

7021-216-340 Magnetism, Relays, and Meters . . . . . ---
- ▪ Define magnetism.
- ▪ Identify characteristics of magnets.
- ▪ Define laws of magnetic attraction and repulsion.
- ▪ Describe properties of magnetic lines of force.
- ▪ Define electromagnetism.
- ▪ Identify the characteristics of electromagnets.
- ▪ Describe the operation of a relay.
- ▪ Describe the operation of a magnetic circuit breaker.
- ▪ Describe the operation of a meter.

7021-216-400 Automotive Troubleshooting I 702, 703, 704
- ▫ Recognize normal operation of a series circuit.
- ▫ Observe and isolate faults in a series circuit.
- ▫ Recognize normal operation of a parallel circuit.
- ▫ Observe and isolate faults in a parallel circuit.
- ▫ Recognize normal operation of a series-parallel circuit.
- ▫ Observe and isolate random faults.

LESSON ID/TITLE CARDS/KITS

MOD 64 - BASIC ELECTRICAL DC AND AC (cont.)

7021-216-920 Basic Electrical DC and AC Post-Test (Theory) ... ---

MOD 65 - BASIC ELECTRONICS FOR AUTOMOTIVE

7021-218-130 Inductor Operation ... 707
- ▪ Identify types of inductors.
- ▪ Describe the current-opposing characteristic of an inductor.
- ▪ Identify the unit of measure for inductance.
- ▪ Identify characteristics of inductance.
- ▪ Identify mutual inductance.
- ▫ Examine characteristics of an inductor.
- ▫ Examine common operations of an inductor.

7021-218-160 Capacitor Operation ... 707
- ▪ Identify types of capacitors.
- ▪ Describe charge and discharge.
- ▪ Identify the schematic symbol for a capacitor.
- ▪ Identify characteristics of capacitance.
- ▪ Identify the unit of measure for capacitance.
- ▫ Examine the circuit characteristics of a capacitor.

7021-218-190 Diode Operation ... 708
- ▪ Identify the purpose of a diode.
- ▪ Recognize diode schematic symbols and use reference designators.
- ▪ Describe the uses of diodes.
- ▫ Analyze diode characteristics in a circuit.

7021-218-220 Transistor Operation ... 709
- ▪ Describe the purpose of a transistor.
- ▪ Describe types of transistors.
- ▪ Identify transistor schematic symbols.
- ▪ Identify leads on transistors.
- ▫ Analyze transistor characteristics in a circuit.

7021-218-250 AND Gates ... 710
- ▪ Identify AND operation.
- ▪ Identify AND logic symbols.
- ▪ Identify AND logic schematic symbols.
- ▪ Construct an AND gate truth table.
- ▪ Identify inputs and outputs.
- ▫ Measure input and output waveforms.

7021-218-280 OR Gates ... 711
- ▪ Identify OR operation.
- ▪ Identify OR logic symbols.
- ▪ Identify OR logic schematic symbols.
- ▪ Construct an OR gate truth table.
- ▪ Identify inputs and outputs.
- ▫ Analyze OR gate circuit operation.

7021-218-310 NOT Gates ... 712
- ▪ Identify NOT operation.
- ▪ Identify NOT logic symbols.

LESSON ID/TITLE CARDS/KITS

MOD 65 - BASIC ELECTRONICS FOR AUTOMOTIVE (cont.)

7021-218-310 NOT Gates (cont.)
- ▪ Identify NOT logic schematic representation.
- ▪ Construct a NOT gate truth table.
- ▪ Identify input and output waveforms.
- ▫ Analyze NOT gate circuit operation.

7021-218-340 Introduction to Combinational Circuits 713B
- ▪ Define combinational logic.
- ▪ Describe the uses of combinational logic.
- ▪ Trace inputs through a combinational logic circuit.
- ▪ Describe the universal property of the NAND gate.
- ▪ Describe the universal property of the NOR gate.
- ▫ Analyze the operation of a combinational circuit.

7021-218-400 Automotive Troubleshooting II 706, 708, 707
- ▫ Recognize normal operation of a relay circuit.
- ▫ Observe and isolate a faulted relay circuit.
- ▫ Recognize normal operation of a diode circuit.
- ▫ Observe and isolate a fault in a diode circuit.
- ▫ Recognize normal operation of an inductive circuit.
- ▫ Observe and isolate random faults.

7021-218-920 Basic Electronics for Automotive Post-Test (Theory) . . . . . ---

MOD 66 - BASIC AUTOMOTIVE SYSTEMS

7021-312-130 Turn Signal Systems 714
- ▪ Describe the use of the turn signal.
- ▪ Examine the characteristics of turn signals.
- ▫ Examine the operation of a turn signal system.

7021-312-160 Starting Systems 715
- ▪ Describe the use of the starting system.
- ▪ Examine the characteristics of different starting system components.
- ▫ Examine the operation of a starting system.

7021-312-190 Ignition Systems 707, 709
- ▪ Identify the components of a Distributor Ignition System.
- ▪ Identify the types of ignition systems.
- ▪ Identify the components of a Distributorless Ignition System.
- ▪ Identify the benefits of Distributorless Ignition Systems.
- ▫ Describe the operation of mechanical and electronic switching circuits.

7021-312-220 Charging Systems 708
- ▪ Identify the components of a charging system.
- ▪ Describe the characteristics of charging systems.
- ▫ Examine the operation of diodes in a charging system.

7021-312-250 Fuel Injection 716
- ▪ Describe the use of fuel injection.
- ▪ Examine the characteristics of different types of fuel injection.
- ▫ Examine the operation and timing of fuel injection in an automobile.

7021-312-280 Engine Cooling and Climate Control 713A
- ▪ Identify the purpose of the engine's cooling system.

LESSON ID/TITLE CARDS/KITS

MOD 66 - BASIC AUTOMOTIVE SYSTEMS (cont.)

7021-312-280 Engine Cooling and Climate Control (cont.)
- ▪ Describe the operation and construction of an engine's cooling system.
- ▪ Describe the operation and construction of the cooling system's components.
- ▪ Describe the operation of electrical circuits used to control the cooling system.
- ▪ Identify the purpose of the environmental climate control system.
- ▪ Describe the operation and construction of an environmental climate control system.
- ▪ Describe the operation and construction of the environmental climate control system components.
- ▪ Describe the operation of electrical circuits used to control the climate control system.
- ▫ Observe the operation of the circulating fan circuit in the air conditioning and engine cooling system.
- ▫ Identify the faulty operation of the circulating fan circuit in the air conditioning and engine cooling system.

7021-312-400 Automotive Troubleshooting III 713A, 714, 715
- ▫ Recognize normal operation of AC and cooling fans.
- ▫ Observe and isolate a faulted AC and cooling fan system.
- ▫ Recognize normal operation of a blinker system.
- ▫ Observe and isolate a fault in a blinker system.
- ▫ Recognize normal operation of an inductive circuit.
- ▫ Observe and isolate random faults.

7021-314-130 Trailer Wiring 720, 721, 720HARNESS
- ▪ Understand the kinds of problems associated with trailer wiring.
- ▪ Understand the process of troubleshooting trailer wiring.
- ▪ Describe the types of test instruments used to troubleshoot trailer wiring.
- ▪ Define a short circuit.
- ▪ Define an open circuit.
- ▫ Perform a basic wiring exercise including continuity and acceptance testing.
- ▫ Recognize common malfunctions in trailer lighting systems.

7021-316-130 Car Audio Systems . . . . . ---
- ▪ Identify the components that make up a car audio system and describe their function.
- ▪ Identify various car audio system components that adjust certain properties of the sound.
- ▪ Identify the components that increase the sound level and convert the electrical signals to audible sound.
- ▪ Understand the proper way to wire the audio system.

7021-316-160 Car Audio Design and Installation CAS1, CAS2, CAS3, CAS4
- ▪ Describe the steps in designing a car audio system.
- ▪ Determine the basic tools needed in order to upgrade a car audio system.
- ▪ Understand the installation procedures.
- ▫ Design an audio system by laying out all audio devices in a functional way.
- ▫ Install the audio system by measuring the proper lengths of wire and connecting the devices correctly.

7021-312-920 Basic Automotive Systems Post-Test (Theory) . . . . . ---

MOD 67 - CAN BUS

7022-412-130 CAN Bus Familiarization 660, 661, 662
- ▪ Examine CAN bus basics.

LESSON ID/TITLE CARDS/KITS

MOD 67 - CAN BUS (cont.)

7022-412-130 CAN Bus Familiarization (cont.)
- ▪ Describe CAN bus specifications.
- ▪ Examine CAN bus automotive applications.
- ▪ Describe OBDII error codes.
- ▫ Test and confirm normal operation of a CAN bus system.
- ▫ Perform measurements on the CAN bus circuitry.
- ▫ Confirm normal operation of a CAN bus system.
- ▫ Troubleshoot CAN bus circuitry.

7022-412-160 CAN Bus Power Distribution 660, 661, 662
- ▪ Examine CAN bus power distribution basics.
- ▫ Test and confirm normal operation of CAN bus power distribution circuitry as part of the CAN bus system.
- ▫ Perform measurements on the CAN bus power distribution circuitry.
- ▫ Confirm the normal operation of CAN bus power distribution circuitry.
- ▫ Troubleshoot CAN bus power distribution circuitry.

7022-412-190 CAN Bus Engine 660, 661, 662
- ▪ Examine CAN bus engine basics.
- ▫ Test and confirm normal operation of CAN bus engine circuitry as part of the CAN bus system.
- ▫ Perform measurements on the CAN bus engine circuitry.
- ▫ Confirm the normal operation of CAN bus engine circuitry.
- ▫ Troubleshoot CAN bus engine circuitry.

7022-412-220 CAN Bus Transmission 660, 661, 662
- ▪ Examine CAN Bus transmission basics.
- ▫ Test and confirm normal operation of CAN bus transmission circuitry as part of the CAN bus system.
- ▫ Perform measurements on the CAN bus transmission circuitry.
- ▫ Confirm the normal operation of CAN bus transmission circuitry.
- ▫ Troubleshoot CAN bus transmission circuitry.

7022-412-250 CAN Bus Lighting-Security 660, 661, 662
- ▪ Examine CAN Bus lighting and security basics.
- ▫ Test and confirm normal operation of CAN bus lighting and security circuitry as part of the CAN bus system.
- ▫ Perform measurements on the CAN bus lighting and security circuitry.
- ▫ Confirm the normal operation of CAN bus lighting and security circuitry.
- ▫ Troubleshoot CAN bus lighting and security circuitry.

7022-412-280 CAN Bus ABS/ESC/TC 660, 661, 662
- ▪ Examine CAN Bus ABS/ESC/TC basics.
- ▫ Test and confirm normal operation of CAN bus ABS/ESC/TC circuitry as part of the CAN bus system.
- ▫ Perform measurements on the CAN bus ABS/ESC/TC circuitry.
- ▫ Confirm the normal operation of CAN bus ABS/ESC/TC circuitry.
- ▫ Troubleshoot CAN bus ABS/ESC/TC circuitry.

7022-412-920 CAN Bus Post-Test (Theory) . . . . . ---

LESSON ID/TITLE CARDS/KITS

MOD 69 - INTRODUCTION TO RESIDENTIAL WIRING

7041-112-130 Electrical Supply Systems and Installations . . . . . ---
- Describe the three parts of an electrical supply system.
- Describe typical voltages in an electrical supply system.
- Describe how electrical wiring information is conveyed to the electrician using symbols and how specifications are used.
- Describe the agencies that are responsible for establishing electrical codes and standards.

7041-112-160 Electrical Symbols and Conductors . . . . . ---
- Describe outlets and recognize their symbols.
- Describe switches and recognize their symbols.
- Describe conductors and recognize their symbols.
- Recognize miscellaneous symbols.
- Describe conductors and their sizes and types.
- Describe the types of conductor insulation.
- Describe conductor color code.

7041-112-190 Electrical Wiring Systems and Boxes . . . . . ---
- Describe how power is brought into a house and how the protection devices are used.
- Describe two and three conductor wiring methods.
- Describe sheathing and conduits and how they are used.
- Describe electrical boxes and how they are used.
- Describe how boxes are installed.
- Describe how boxes are wired for outlets, switches, and connections.

7041-112-220 Electrical Switches, Interrupters, and Suppressors . . . . . ---
- Describe standard 1-pole switch wiring.
- Describe three-way switch wiring.
- Describe four-way switch wiring.
- Describe 2-pole switch wiring.
- Describe Ground Fault Circuit Interrupters (GFCI).
- Describe Immersion Detection Circuit Interrupters (IDCI).
- Describe Transient Voltage Surge Suppressors (TVSS).
- Describe Isolated Ground Receptacles (IG).

7041-112-250 Recessed Lighting and Ballast . . . . . ---
- Describe the voltages used for residential lighting and the factors to consider before installation.
- Describe recessed lighting installation.
- Describe ballasts.
- Describe ballast installation.

7041-112-280 Branch Circuits and Conductor Sizing . . . . . ---
- Describe how the number of branch circuits is determined.
- Describe how the number of outlets per branch circuit is determined.
- Use NEC Table 310-16 to determine allowable amperage of conductors.
- Describe the de-rating factors and restrictions on amperage for NEC Table 310-16.

MOD 70 - ROOM BRANCH CIRCUITS

7041-114-130 Bedroom and Master Bedroom Circuits . . . . . ---
- Describe the methods used to group outlets.
- Describe the general wiring methods for bedrooms and how receptacles are placed.

LESSON ID/TITLE CARDS/KITS

MOD 70 - ROOM BRANCH CIRCUITS (cont.)

7041-114-130 Bedroom and Master Bedroom Circuits (cont.)
- Describe how lighting fixtures are used in closets to meet NEC requirements.
- Describe the general wiring methods for master bedrooms.
- Describe the use of two circuit receptacles.
- Describe NEC requirements for paddle fans.

7041-114-160 Bathroom, Hallway, Front Porch, and Entry Circuits . . . . . ---
- Define a bathroom according to the NEC.
- Describe the wiring of receptacles in bathrooms.
- Describe the lighting requirements in bathrooms.
- Describe equipment grounding requirements in bathrooms.
- Describe hallway circuits including three-way switches.
- Describe front porch and entry.

7041-114-190 Kitchen, Dining, and Living Room Circuits . . . . . ---
- Describe receptacle requirements for small appliance circuits in kitchens, dining rooms, breakfast rooms, and pantries.
- Describe split circuit applications used in kitchens.
- Describe lighting requirements in dining rooms.
- Describe equipment grounding requirements in dining rooms.
- Describe receptacle requirements in living rooms.
- Describe lighting requirements in living rooms.
- Describe the use of track lighting and dimmer controls used in living rooms.

7041-114-220 Laundry, Study, Rear Entry, and Attic Circuits . . . . . ---
- Describe receptacle and lighting requirements for laundry rooms.
- Describe electric dryer connection methods to include circuit sizing.
- Describe electric dryer frame grounding requirements.
- Describe receptacle and lighting requirements for study rooms to include valance lighting and the use of surge protectors.
- Describe receptacle and lighting requirements for rear entries.
- Describe receptacle and lighting requirements for attics (including crawl spaces, rooftops, and equipment rooms).

7041-114-250 Family Room and Garage Circuits . . . . . ---
- Describe receptacle and lighting requirements for family rooms.
- Describe the use and precautions for multi-wire circuits.
- Describe receptacle and lighting requirements for garage circuits.
- Describe the use and NEC regulations for outdoor outlets and wiring.

7041-114-280 Workshop and Basement Circuits . . . . . ---
- Describe receptacle and lighting requirements for workshops.
- Describe the use of multi-outlet assemblies.
- Describe receptacle and lighting requirements for basements.

MOD 71 - SPECIAL PURPOSE BRANCH CIRCUITS

7041-116-130 Water Pump and Water Heater Circuits . . . . . ---
- Describe the operation of jet pumps and submersible pumps.
- Describe wiring for jet pumps and submersible pumps.
- Describe conductor and overcurrent device sizing for jet pumps and submersible pumps.
- Describe the operation of water heaters.

LESSON ID/TITLE CARDS/KITS

MOD 71 - SPECIAL PURPOSE BRANCH CIRCUITS (cont.)

7041-116-130 Water Pump and Water Heater Circuits (cont.)
- Describe wiring for water heaters.
- Describe conductor and overcurrent device sizing for water heaters.

7041-116-160 Large Kitchen Appliance Circuits . . . . . ---
- Describe the operation of ovens and stoves.
- Describe the wiring of ovens and stoves.
- Describe conductor and overcurrent device sizing for ovens and stoves.
- Describe the operation of food waste disposers and dishwashers.
- Describe the wiring for food waste disposers and dishwashers.
- Describe conductor and overcurrent device sizing for food waste disposers and dishwashers.

7041-116-190 Vent Fans and Hydromassage Tub Circuits . . . . . ---
- Describe vent fan operation.
- Describe the wiring of vent fans.
- Describe conductor and overcurrent device sizing for vent fans.
- Describe hydromassage tub operation.
- Describe the wiring for hydromassage tubs.
- Describe conductor and overcurrent device sizing for hydromassage tubs.

7041-116-220 Electric Heating and Air Conditioning . . . . . ---
- Describe the operation of electric heaters.
- Describe the wiring of electric heating systems.
- Describe the operation of air conditioner systems.
- Describe the wiring of air conditioner systems.

7041-116-250 Oil and Gas Heating & Heat and Smoke Detectors . . . . . ---
- Describe the operation of oil and gas heaters.
- Describe the wiring of oil and gas heater systems.
- Describe the operation of heat/smoke detectors.
- Describe the wiring of heat/smoke detector systems.

7041-116-280 Television and Telephone Systems . . . . . ---
- Identify the different types of television signal sources.
- Describe the wiring of television systems.
- Understand the needs of telephone wiring.
- Describe the wiring of telephone systems.

7041-116-310 Service Entrance Equipment and Calculations . . . . . ---
- Understand the needs for service entrance equipment.
- Describe the wiring of service entrance equipment.
- Understand the purpose of service entrance calculations.
- Perform service entrance calculations.

7041-116-340 Swimming Pool and Spa Wiring . . . . . ---
- Understand the dangers of wiring swimming pool equipment.
- Describe the wiring of swimming pool equipment.
- Understand the danger of wiring spa equipment.
- Describe the wiring of spa equipment.

MOD 74 - COMMERCIAL WIND ENERGY SYSTEMS

LESSON ID/TITLE CARDS/KITS

MOD 74 - COMMERCIAL WIND ENERGY SYSTEMS (cont.)

7232-112-130 Introduction to Renewable Energy Systems . . . . . ---
- Express the need for renewable energy.
- Explain the four interdependent elements of renewable energy systems.
- Understand renewable energy sources.
- Describe energy conversion technologies.

7232-112-160 Energy Sources and Site Surveys . . . . . ---
- Describe renewable energy resources (wind, solar, hydroelectric, ocean wave, ocean tidal, ocean current, ocean thermal conversion, geothermal).
- Illustrate energy resources (wind, solar).
- Explain the use of a site survey.
- Describe how to perform a site survey.

7232-116-130 Wind Turbine System Fundamentals . . . . . ---
- Describe the types of wind turbines (HAWT and VAWT).
- Describe the differences between commercial and residential wind generation.
- Recognize safe wind turbine maintenance methods.
- Explain commercial wind power subsystem operation (generator, gearing, cooling, control, yaw, pitch, brake).

7232-116-160 3-Phase Power Fundamentals . . . . . ---
- Describe 3-phase power.
- Describe the operation of an AC generator.
- Describe the operation of inverters.
- Describe the difference between 50 Hz and 60 Hz power.

7232-116-190 Wind Turbine System Maintenance and Diagnostics . . . . . ---
- Recognize wind turbine preventive/scheduled and unscheduled maintenance routines.
- Describe physical inspection techniques for a wind turbine system.
- Recognize unscheduled maintenance routines.
- Describe when unscheduled maintenance is necessary.

7232-116-220 Wind Turbine System Malfunctions and Troubleshooting . . . . . ---
- Examine the troubleshooting process for wind turbine systems.
- Describe the basic tools used to troubleshoot commercial wind turbine systems.

MOD 75 - COMMERCIAL SOLAR ENERGY SYSTEMS

7232-118-130 Solar Thermal System Fundamentals . . . . . ---
- Express the need for solar thermal power as a renewable energy.
- Differentiate non-concentrating and concentrating thermal collectors.
- Explain the three main classes of solar thermal collectors.
- Examine solar pool heating systems.
- Examine solar water heating systems.
- Examine solar space heating systems.
- Examine parabolic trough systems.
- Examine solar dish (Stirling engine) systems.
- Examine solar power tower systems.

7232-118-160 Solar Photovoltaic System Fundamentals . . . . . ---
- Express the need for solar photovoltaic power as a renewable energy.
- Explain the photovoltaic (PV) effect and construction.
- Describe solar resources.

LESSON ID/TITLE CARDS/KITS

MOD 75 - COMMERCIAL SOLAR ENERGY SYSTEMS (cont.)

7232-118-160 Solar Photovoltaic System Fundamentals (cont.)
- ▪ Describe general solar photovoltaic personal protective equipment.
- ▪ Explain proper installation procedures.
- ▪ Recognize safe installation and maintenance methods.
- ▪ Recognize solar PV system common tools.

7232-118-190 Solar Photovoltaic System Maintenance and Diagnostics . . . . . ---
- ▪ Recognize solar photovoltaic preventive/scheduled and unscheduled maintenance routines.
- ▪ Describe physical inspection techniques for solar photovoltaic systems.
- ▪ Recognize unscheduled maintenance routines.
- ▪ Describe when unscheduled maintenance is necessary.

7232-118-220 Solar Photovoltaic System Malfunctions and Troubleshooting . . . . . ---
- ▪ Examine the troubleshooting process for solar photovoltaic systems.
- ▪ Describe the basic tools used to troubleshoot solar photovoltaic systems.

MOD 76 - POWER DISTRIBUTION

7232-714-130 3-Phase Fundamentals 640, 641, 642
- ▪ Express the use of 3-phase power.
- ▪ Describe the operation of an AC generator.
- ▪ Describe the differences between 3-phase and single-phase services.
- ▪ Describe the difference between 50 Hz and 60 Hz power.
- ▪ Describe the operation of inverters.
- ▫ Read a 3-phase power transmission block diagram.
- ▫ Operate a 3-phase power transmission and distribution system.
- ▫ Verify the presence of 3-phase power using an oscilloscope.

7232-714-160 Power Transmission and Distribution Fundamentals 640, 641, 642
- ▪ Express the need for power transmission and distribution.
- ▪ Describe the use of a power transmission system.
- ▪ Give a brief description of power distribution.
- ▪ Discuss power stabilization techniques.
- ▪ Describe the operation of grid-tie interfacing.
- ▪ Recognize tools used on power transmission and distribution systems.
- ▪ Recognize safe maintenance methods.
- ▫ Initialize a power transmission and distribution system using default settings.
- ▫ Validate system operation using sensors, monitors, and display devices.
- ▫ Power down the power transmission and distribution system.

7232-714-190 3-Phase and Single-Phase Service Feeds 640, 641, 642
- ▪ Analyze the use of 3-phase service feeds.
- ▪ Describe 3-phase service feeds.
- ▪ Analyze the use of single-phase service feeds.
- ▪ Describe single-phase service feeds.
- ▫ Initialize a power distribution system using default settings.
- ▫ Analyze 3-phase service feeds.
- ▫ Analyze single-phase service feeds.
- ▫ Power down the power transmission and distribution system.

7232-714-220 Power Transmission and Distribution Maintenance 640, 641, 642
- ▪ Recognize power transmission and distribution preventive/scheduled maintenance routines.

LESSON ID/TITLE CARDS/KITS

MOD 76 - POWER DISTRIBUTION (cont.)

7232-714-220 Power Transmission and Distribution Maintenance (cont.)
- ▪ Describe physical inspection techniques for power transmission and distribution systems (visual and sound).
- ▪ Recognize power transmission and distribution unscheduled maintenance routines.
- ▪ Describe when unscheduled maintenance is necessary.
- ▫ Initialize a power transmission and distribution system using default settings.
- ▫ Perform a power transmission and distribution system operational check.
- ▫ Show proper use of measurement devices.
- ▫ Examine power transmission and distribution system fault isolation procedures.
- ▫ Demonstrate the ability to diagnose a defective subsystem in a power transmission and distribution system using fault isolation procedures.

7232-714-250 Power Grid Troubleshooting 640, 641, 642
- ▪ Examine the troubleshooting process for power transmission and distribution systems.
- ▫ Set up a power transmission and distribution system hardware following a given procedure.
- ▫ Initialize a power transmission and distribution system with default settings.
- ▫ Perform a power transmission and distribution system operational check.
- ▫ Show proper use of measurement devices.
- ▫ Demonstrate the ability to maintain a power transmission and distribution system.
- ▫ Power down a power transmission and distribution system.

7232-714-920 Power Distribution Post-Test (Theory) . . . . . ---

MOD 77 - AC MOTORS

7272-412-130 Single-Phase and 3-Phase Motor Familiarization 650, 651, 652, 653
- ▪ Explain advantages of AC motors over DC motors in industrial applications.
- ▪ Identify DC, AC single-phase, and three-phase power signals.
- ▪ Describe advantages and disadvantages of multiple-phase power as related to motors.
- ▫ Perform the proper wiring techniques for single-phase motors.
- ▫ Test and verify operation of a single-phase shaded-pole motor.
- ▫ Perform the proper wiring techniques for 3-phase wye-configured motors.
- ▫ Test and verify operation of a 3-phase wye-configured motor.

7272-414-130 Universal Motor Operation 650, 651, 652
- ▪ Identify benefits and drawbacks of universal motors.
- ▫ Configure a universal motor for single-phase AC operation.
- ▫ Demonstrate ways to reverse the direction of a universal motor.

7272-414-160 Shaded-Pole Motors 650, 651, 652
- ▪ Identify benefits and drawbacks for shaded-pole motors.
- ▪ Describe the configuration of an operational shaded-pole motor.
- ▪ Explain the steps necessary to reverse the direction of a shaded-pole motor.
- ▫ Perform the proper wiring techniques for a shaded-pole motor using single-phase AC.

7272-414-190 Split-Phase Motors 650, 651, 652
- ▪ Describe the construction of split-phase motors.
- ▫ Perform the proper wiring techniques for split-phase motors in both CW and CCW rotation directions.

7272-414-220 Permanent Split Capacitor Motors 650, 651, 652
- ▪ Describe the construction of permanent split capacitor motors.
- ▫ Perform the proper wiring techniques for a permanent split capacitor motor in both CW and CCW rotation directions.

LESSON ID/TITLE — CARDS/KITS

MOD 77 - AC MOTORS (cont.)

7272-414-250 Capacitor Start Motors 650, 651, 652
- ▪ Describe the construction of capacitor start motors.
- ▫ Perform the proper wiring techniques for a capacitor start motor in both CW and CCW rotation directions.

7272-414-280 Capacitor Start / Capacitor Run Motors 650, 651, 652
- ▪ Describe the construction of capacitor start / capacitor run motors.
- ▪ Demonstrate knowledge of the theory of the capacitor start / capacitor run motor.
- ▫ Perform the proper wiring techniques for a capacitor start/capacitor run motor in both CW and CCW rotation directions.

7272-414-920 Single-Phase Motors Post-Test (Theory) . . . . . ---

7272-416-130 3-Phase Wye/Star Motors 650, 651, 653
- ▪ Describe the construction of 3-phase wye/star motors.
- ▫ Configure a wye/star motor for 3-phase AC operation.
- ▫ Demonstrate ways to reverse the direction of a 3-phase wye/star motor.

7272-416-160 3-Phase Delta Motors 650, 651, 653
- ▪ Describe the construction of 3-phase delta motors.
- ▫ Configure a delta motor for 3-phase AC operation.
- ▫ Demonstrate ways to reverse the direction of a 3-phase delta motor.

7272-416-190 3-Phase Wye/Star-Delta Motor Starters 650, 651, 653
- ▪ Describe the need for 3-phase starters.
- ▪ Discuss the advantages and disadvantages of the 3-phase wye/star-delta motor starter.
- ▫ Configure a wye/star-delta motor for 3-phase AC operation.
- ▫ Demonstrate ways to reverse the direction of a wye/star-delta motor.

7272-416-220 3-Phase Resistive and Autotransformer Motor Starters 650, 651, 653
- ▪ Describe the need for 3-phase starters.
- ▪ Discuss the advantages and disadvantages of alternative 3-phase motor starters.
- ▫ Set up a 3-phase motor using the primary resistive starting configuration.
- ▫ Demonstrate how to reverse the direction of a primary resistive starting configuration.
- ▫ Set up a 3-phase motor using the primary autotransformer starting configuration.
- ▫ Demonstrate ways to reverse the direction of an autotransformer starting configuration.

7272-416-250 AC Motor Frequency and Voltage Controllers 650, 651, 653
- ▪ Describe the need for 3-phase starters.
- ▪ Identify the electronic starter benefits over other starters.
- ▪ Demonstrate knowledge of AC motor frequency and voltage controllers.
- ▫ Configure a soft starter configured motor for 3-phase AC operation.
- ▫ Demonstrate ways to reverse the direction of a soft starter configured 3--phase motor.

7272-416-920 3-Phase Motors Post-Test (Theory) . . . . . ---

MOD 78 - INTRO TO PROCESS AUTOMATION

7242-112-130 Fundamentals of Industrial Safety . . . . . ---
- ▪ Understand common safety concerns in industrial settings.
- ▪ Explain methods used to enhance safety.
- ▪ Define lockout-tagout.
- ▪ Explain procedures involved with lockout-tagout.

7242-112-160 Using Industrial Control Diagrams . . . . . ---
- ▪ Identify basic characteristics found on control diagrams.

LESSON ID/TITLE CARDS/KITS

MOD 78 - INTRO TO PROCESS AUTOMATION (cont.)

7242-112-160 Using Industrial Control Diagrams (cont.)
- Trace signal flow through a typical industrial diagram.

7242-112-190 Introduction to Troubleshooting . . . . . ---
- Define troubleshooting.
- Compare component and system level troubleshooting.
- Recognize various troubleshooting methods.

7242-112-220 Introduction to Automated Systems . . . . . ---
- Identify basic functions of automated systems.
- Review open loop and closed loop control.

7242-112-250 Introduction to Process Control . . . . . ---
- Describe the basic elements of process control.
- Define common terms associated with process control.

7242-112-280 Batch and Continuous Processing . . . . . ---
- Describe the function and operation of continuous processing.
- Describe the function and operation of batch processing.

MOD 79 - INSTRUMENTATION

7242-212-130 Introduction to Instrumentation . . . . . ---
- Describe the basic purpose of instrumentation devices used in automated industrial systems.
- Describe the basic function of elements of an electromechanical instrumentation system.
- Describe the basic function of elements of a hydraulic instrumentation system.
- Describe the basic function of elements of a pneumatic instrumentation system.

7242-212-160 Sensor Fundamentals . . . . . ---
- Explain the purpose of a sensor.
- Understand important physical characteristics that are common to sensors.
- Define important operational characteristics that are common to sensors.

7242-212-190 Actuator Fundamentals . . . . . ---
- Identify functions of actuators used in industry.
- Explain terms and basic principles associated with pneumatic and hydraulic instrumentation.
- Describe actuator types most often used in industry.

7242-214-130 Position, Proximity, and Displacement Sensors . . . . . ---
- Describe the different types of position sensors and their applications.
- Describe the different types of proximity sensors and their application.
- Describe the different types of displacement sensors and their applications.

7242-214-160 Motion Sensors . . . . . ---
- Describe the different types of motion sensors and their applications.

7242-214-190 Velocity Sensors . . . . . ---
- Describe the different types of velocity sensors and their applications.

7242-214-220 Vibration Sensors . . . . . ---
- Describe the different types of vibration sensors and their applications.

7242-214-310 Temperature and Humidity Sensors . . . . . ---
- Describe IR heat generation.
- Describe friction heat generation.
- Describe chemical heat generation.
- Describe heat dissipation.
- Describe mechanical heat sensors.

LESSON ID/TITLE CARDS/KITS

MOD 79 - INSTRUMENTATION (cont.)

7242-214-310 Temperature and Humidity Sensors (cont.)
- Describe thermocouples.
- Describe thermistors.
- Describe the different types of humidity sensors and their applications.

7242-214-430 LVDT Displacement Sensor . . . . . ---
- Describe the operation of LVDT sensors.

7242-216-130 Electromechanical Actuator Types and Applications . . . . . ---
- Describe electromechanical positional actuators and their applications.
- Describe electromechanical directional actuators and their applications.
- Describe electromechanical rotational actuators and their applications.
- Describe electromechanical regulatory actuators and their applications.

MOD 80 - CONTROLLERS

7242-312-130 System Process Controller Fundamentals . . . . . ---
- Explore the history, present state, and future of process controllers.
- Categorize discrete, batch, and continuous process control requirements.
- Identify differences between the Programmable Logic Controller (PLC) and the Programmable Automation Controller (PAC).
- Describe the functions of the Human Machine Interface (HMI) and the Remote Terminal Unit (RTU).
- Identify differences between a Distributed Control System (DCS) and a Supervisory Control and Data Acquisition (SCADA) system.

7242-312-160 PID Controllers . . . . . ---
- Identify the principles of proportional and derivative control.
- Identify the principles of proportional and integral control.
- Identify the principles of proportional, integral, and derivative control.

7242-314-130 PLC System Fundamentals . . . . . ---
- Describe the function of the basic components of the programmable logic controller.
- Discuss the types of inputs and outputs used with the PLC.
- Recognize and understand a simple ladder logic diagram.
- Recognize the symbols used in a basic ladder logic diagram.

7242-314-160 PAC System Fundamentals . . . . . ---
- Describe the function of the basic components of the programmable automation controller system.
- Compare PLC logic to PAC logic.
- Discuss the methods used to program a PAC.

7242-316-130 Distributed Control (DCS) . . . . . ---
- Describe DCS system architecture.
- Define and identify a block diagram of a DCS system.

7242-316-160 Supervisory Control and Data Acquisition (SCADA) . . . . . ---
- Describe SCADA system architecture.
- Define and identify a block diagram of a SCADA system.
- Describe the differences between DCS and SCADA Systems.

MOD 81 - INTEGRATION

LESSON ID/TITLE CARDS/KITS

MOD 81 - INTEGRATION (cont.)

7242-412-130 Fundamentals of Industrial Systems Integration . . . . . ---
- Define HMI functions.
- Define M2M functions.
- Discuss standards used for modern industrial control systems.

7242-414-130 4-20 mA Current Loop . . . . . ---
- Examine 4-20mA current loop basics.

7242-414-160 Hardware Standard EIA-232 . . . . . ---
- Explore hardware standard EIA-232.
- Compare EIA-232 benefits and limitations.
- Identify standard connectors and pin layouts used.

7242-414-190 Hardware Standards EIA-422 and 485 . . . . . ---
- Explore hardware standard EIA-422 and 485.
- Compare EIA-422 and 485 maximum allowed distances, maximum number of allowed devices, voltages, and protocols for each standard.

7242-414-220 Ethernet . . . . . ---
- Explore hardware standardsTIA-568A and TIA-568B.
- Examine an industrial system using TCP/IP Internet Protocol Suite.
- Demonstrate knowledge of static and dynamic TCP/IP address assignments.

MOD 82 - BASIC MATHEMATICS

2011-112-130 Adding and Subtracting . . . . . ---
- Describe the decimal number system.
- Describe the whole number line.
- Describe addition.
- Add whole numbers.
- Describe subtraction.
- Subtract whole numbers.

2011-112-160 Multiplying and Dividing . . . . . ---
- Describe multiplication.
- Multiply whole numbers.
- Describe division.
- Divide whole numbers.

2011-112-190 Fractions . . . . . ---
- Describe fractions.
- Describe proper and improper fractions.
- Change improper fractions to whole numbers or mixed numbers.
- Change mixed numbers to improper fractions.
- Reduce fractions to the lowest terms.

2011-112-220 Fraction Operations . . . . . ---
- Add fractions.
- Subtract fractions.
- Multiply fractions.
- Divide fractions.

2011-112-250 Decimal Fractions . . . . . ---
- Describe decimal fractions.
- Recognize positional values in decimal fractions.

LESSON ID/TITLE CARDS/KITS

MOD 82 - BASIC MATHEMATICS (cont.)

2011-112-250 Decimal Fractions (cont.)
- Convert decimal fractions to standard fractions.
- Convert standard fractions to decimal.
- Add decimal fractions.
- Subtract decimal fractions.
- Multiply decimal fractions.
- Divide decimal fractions.

2011-112-280 Signed Numbers . . . . . ---
- Describe signed numbers.
- Describe the signed number line.
- Determine the relationship between two signed numbers.
- Add signed numbers.
- Subtract signed numbers.
- Multiply signed numbers.
- Divide signed numbers.

2011-112-310 Percents . . . . . ---
- Describe percents.
- Change percents to decimal numbers.
- Change decimal numbers to percents.
- Calculate the percentage part.
- Calculate the percentage rate.
- Calculate the percentage base.

2011-112-340 Exponents and Square Roots . . . . . ---
- Describe exponents.
- Calculate the result of numbers that use exponents.
- Describe square roots.
- Calculate square roots.

2011-112-370 Metric Notation . . . . . ---
- Convert decimal numbers to powers of ten and vice versa.
- Convert decimal numbers to metric prefixes and vice versa.
- Add, subtract, multiply, and divide powers of ten.
- Add, subtract, multiply, and divide metric prefixes.

2011-112-920 Basic Mathematics Post-Test (Theory) . . . . . ---

MOD 83 - ALGEBRA

2011-212-130 Fundamentals of Algebra . . . . . ---
- Describe real numbers.
- Describe the four fundamental operations of real numbers.
- Describe real number variables.
- Describe the order of operations.
- Combine variables.
- Describe real number properties - closure, commutative, associative, identity, inverse, distributive.

2011-212-160 Linear Equations . . . . . ---
- Describe addition and subtraction laws.
- Solve X + A = B type of equations.

LESSON ID/TITLE CARDS/KITS

MOD 83 - ALGEBRA (cont.)

2011-212-160 Linear Equations (cont.)
- Solve X - A = B type of equations.
- Describe multiplication and division laws.
- Solve X x A = B type of equations.
- Solve X ÷ A = B type of equations.
- Describe a formula.
- Place a word problem in an equation.
- Solve for the unknown quantity.

2011-212-190 Solving Linear Equations . . . . . ---
- Use the basic laws of equations to solve linear equations.
- Solve problems in the format of ax + b = c and ax - b = c.
- Solve problems in the format of x/a + b = c.
- Use the four-step process to solve word problems.
- Solve word problems in the format of linear equations.

2011-212-220 Exponents and Monomials . . . . . ---
- Define exponents.
- Multiply and divide powers with the same base.
- Raise a power to a power.
- Raise a product or quotient to a power.
- Describe monomials.
- Add and subtract monomials.
- Multiply and divide monomials.
- Use the 4 steps to solve word problems.
- Solve word problems that use monomials.

2011-212-250 Polynomials . . . . . ---
- Define polynomials.
- Add polynomials.
- Subtract polynomials.
- Multiply a monomial and a polynomial.
- Multiply polynomials.
- Describe special binomial products.
- Divide polynomials by monomials.

2011-212-280 Factoring Polynomials . . . . . ---
- Factor by finding the greatest common factor.
- Factor by grouping.
- Factor trinomials.
- Factor by recognizing special binomial factors.
- Solve equations by factoring.
- Define quadratic equations and quadratic formula.
- Solve equations using the quadratic formula.
- Solve word problems.

2011-212-310 Roots and Radicals . . . . . ---
- Factor radicand terms.
- Simplify using the Product Property of Roots.
- Simplify using the Product Quotient Property of Roots.
- Rationalize denominators.
- Multiply radicals.

LESSON ID/TITLE CARDS/KITS

MOD 83 - ALGEBRA (cont.)

2011-212-310 Roots and Radicals (cont.)
- Divide radicals.
- Add radicals.
- Subtract radicals.
- Rationalize denominators.
- Use the Squaring Property of Equations to solve for the unknown.
- Solve equations containing one radical expression.
- Solve equations containing two radical expressions.

2011-212-340 Graphs . . . . . ---
- Describe the rectangular coordinate system.
- Locate points on a rectangular coordinate system.
- Find the coordinates of a point in a rectangular coordinate system.
- Graph linear equations.
- Find the slope of a line.
- Find the equation of a line.

2011-212-370 Systems of Linear Equations . . . . . ---
- Define a system of equations.
- Solve systems of equations by graphing.
- Identify consistent, inconsistent, and dependent systems by their graphs.
- Solve systems of equations by substitution.
- Identify consistent, inconsistent, and dependent systems by the results of substitution.
- Solve systems of equations by addition.
- Identify consistent, inconsistent, and dependent systems by the results of addition.

2011-212-400 Introduction to Statistics . . . . . ---
- Understand the role of statistics in industry.
- Understand the concepts of mean, median, mode, standard deviation, percentiles, and quartiles.
- Understand the analysis of statistical data.
- Understand the various statistical diagrams.
- Understand the statistical histogram.

2011-212-920 Algebra Post-Test (Theory) . . . . . ---

MOD 84 - TRIGONOMETRY

2011-214-130 Fundamentals of Trigonometry . . . . . ---
- Define the term angle.
- Identify positive angles and negative angles.
- Identify acute, obtuse, complementary, and supplementary angles.
- Identify angle measurements using degrees, minutes, and seconds.
- Add and subtract angle measurements.
- Understand the relationship between degrees and radians.
- Convert degrees into radians.
- Convert radians into degrees.

2011-214-160 Trigonometric Functions . . . . . ---
- Find the measurement of an unknown angle in a right triangle.
- Find the unknown side of a right triangle using the Pythagorean Theorem.
- Identify the properties of the 45-45-90 and 30-60-90 right triangles.

LESSON ID/TITLE CARDS/KITS

MOD 84 - TRIGONOMETRY (cont.)

2011-214-160 Trigonometric Functions (cont.)
- Identify the six trigonometric functions.
- Find the sine, cosine, tangent, cosecant, secant, and cotangent of a given angle.
- Identify the relationships between the unit circle and the trigonometric functions.

2011-214-190 Graphing Trigonometric Functions . . . . . ---
- Identify the basic graphs for the six trigonometric functions.
- Define period and amplitude.
- Define the period and amplitude for the six trigonometric functions.
- Determine the amplitude of the sine and cosine functions.
- Find the change in the period of a trigonometric function.
- Determine the phase shift of a trigonometric function.

2011-214-220 Trigonometric Identities . . . . . ---
- Understand the origins of the reciprocal and ratio identities.
- Find the trigonometric function of an angle using either a reciprocal or ratio identity.
- Find the trigonometric function of an angle using combinations of reciprocal and ratio identities.
- Understand the origins of the Pythagorean and related identities.
- Find the trigonometric function of an angle using the Pythagorean and related identities.

2011-214-250 Angle Formulas . . . . . ---
- Know the sum and difference formulas for sine, cosine, and tangent.
- Find the exact trigonometric function value of a given angle using the sum and difference formulas.
- Know the double angle formulas for sine, cosine, and tangent.
- Know the power reducing formulas for sine, cosine, and tangent.
- Know the half-angle formulas for sine, cosine and tangent.
- Use the proper formula to find the exact trigonometric value of a given angle.

2011-214-280 Inverse Trigonometric Functions . . . . . ---
- Understand the methods for finding the inverse trigonometric functions.
- Know the domains, ranges, and graphs of arcsine, arccosine, and arctangent.
- Solve problems involving arcsine, arccosine, and arctangent.
- Know the domains, ranges, and graphs of arccosecant, arcsecant, and arccotangent.
- Solve problems involving arccosecant, arcsecant, and arccotangent.

2011-214-310 Applications of Trigonometry . . . . . ---
- Identify an oblique triangle.
- Use the law of sines to find the missing parts of oblique triangles.
- Understand the four possibilities resulting from the ambiguous case.
- Use the law of cosines to solve oblique triangles when given two sides and the included angle.
- Use the law of cosines to solve oblique triangles when given three sides.

2011-214-340 Graphing Polar Equations . . . . . ---
- Define the polar coordinate pair.
- Graph polar coordinates.
- Understand the techniques for graphing polar equations.
- Recognize and graph basic polar equations.

2011-214-370 Conic Sections: Circles and Parabolas . . . . . ---
- Recognize the general equation for a circle.
- Find the center and radius of a circle from a given equation.

LESSON ID/TITLE CARDS/KITS

MOD 84 - TRIGONOMETRY (cont.)

2011-214-370 Conic Sections: Circles and Parabolas (cont.)
- Find the equation for a circle given the center and radius.
- Recognize the general equations for parabolas.
- Find the focus, vertex, and directrix of a parabola from a given equation.
- Find the equation for a parabola given the focus, vertex, and/or directrix.

2011-214-400 Conic Sections: Ellipses and Hyperbolas . . . . . ---
- Recognize the general equations for ellipses.
- Find the center, vertices, and foci of an ellipse from a given equation.
- Find the equation for an ellipse given the center, vertices, and foci.
- Recognize the general equations for hyperbolas.
- Find the center, vertices, foci, and asymptotes of a hyperbola from a given equation.
- Find the equation for a hyperbola given the center, vertices, and foci.

2011-214-920 Trigonometry Post-Test (Theory) . . . . . ---

MOD 85 - CALCULUS

2011-216-130 Fundamentals of Calculus . . . . . ---
- Apply the slope formula to particles moving along straight paths.
- Recognize functions and identify the domain and range.
- Find the composite of two given functions.
- Find the average rate of change of a function.
- Understand the transition as a secant line becomes a tangent line when ΔX goes to 0.
- Find the slope at a given point on a curve.

2011-216-160 Limits . . . . . ---
- Understand the concept of a limit.
- Recognize right-hand limits and left-hand limits.
- Find limit values.
- Understand the sandwich property.
- Understand how the sandwich property is used to find the limits of trigonometric functions.
- Find limits involving trigonometric functions.

2011-216-190 Limits: Continuity and Infinity . . . . . ---
- Identify continuous functions.
- Determine continuity at a point.
- Determine continuity over an interval.
- Understand how infinity is used as a limit.
- Identify the limit form as the variable approaches infinity.
- Find limits involving infinity.

2011-216-220 Derivatives . . . . . ---
- Understand the definition of a derivative.
- Find derivatives using the definition.
- Find derivatives using the constant rule, power rule, and sum rule.
- Find the derivative of the product of two functions.
- Find the derivative of the quotient of two functions.

2011-216-250 The Chain Rule . . . . . ---
- Identify the chain rule.
- Find derivatives using the chain rule.
- Identify the derivatives of the six trigonometric functions.

LESSON ID/TITLE CARDS/KITS

MOD 85 - CALCULUS (cont.)

2011-216-250 The Chain Rule (cont.)
- Find derivatives of functions using trigonometric expressions.

2011-216-280 Additional Differentiation Methods . . . . . ---
- Identify implicit functions.
- Find derivatives using implicit differentiation.
- Identify higher order derivatives.
- Find second and third derivatives of functions.
- Find the velocity and acceleration functions given the position function.

2011-216-310 Applications of Derivatives . . . . . ---
- Sketch curves using the first and second derivatives.
- Identify intervals where the function is increasing or decreasing.
- Locate local maximum or minimum points.
- Determine concavity.
- Find inflection points.
- Develop strategy for solving maxima-minima word problems.
- Solve max-min problems.

2011-216-340 Integration . . . . . ---
- Understand the relationship between integration and differentiation.
- Integrate simple algebraic indefinite integrals.
- Integrate simple trigonometric indefinite integrals.
- Identify integrals resulting from use of the chain rule.
- Integrate indefinite integrals using the u substitution method.

2011-216-370 Definite Integrals . . . . . ---
- Understand the relationship between the limits of integration and an interval of x values.
- Identify upper and lower limits of integration.
- Evaluate definite integrals.
- Use definite integrals to find the area involving only positive regions.
- Use definite integrals to find the area of both positive and negative regions.

2011-216-400 Applications of Definite Integrals . . . . . ---
- Find the area of a region bounded by two curves.
- Find the area of a region bounded by two curves and the x-axis.
- Understand the theory of rotation about the x-axis.
- Find the volume of an object formed by rotating y = f(x) about the x-axis.

2011-216-920 Calculus Post-Test (Theory) . . . . . ---

MOD 86 - COMPUTER MATH

2011-312-130 Fundamentals of Computer Math . . . . . ---
- Understand concept of number systems other than base 10.
- Add and subtract numbers of base N.
- Convert numbers of base N to base 10.
- Convert numbers of base 10 to base N.
- Construct a base N multiplication table.
- Multiply and divide base N numbers.

2011-312-160 The Binary System . . . . . ---
- Add and subtract binary numbers.
- Convert binary numbers to decimal numbers.

LESSON ID/TITLE CARDS/KITS

MOD 86 - COMPUTER MATH (cont.)

2011-312-160 The Binary System (cont.)
- Convert decimal numbers to binary numbers.
- Use BCD (8421) codes.
- Use Gray codes.
- Use ASCII codes.
- Use Unicode.

2011-312-190 Octal and Hexadecimal Systems . . . . . ---
- Perform computations using octal numbers.
- Convert binary numbers to octal numbers.
- Convert octal numbers to binary numbers.
- Convert hexadecimal numbers to decimal numbers.
- Convert decimal numbers to hexadecimal numbers.
- Convert binary numbers to hexadecimal numbers.
- Convert hexadecimal numbers to binary numbers.

2011-312-220 Logic Expressions . . . . . ---
- Identify a valid logic statement.
- Describe a negated logic statement.
- Identify and use the "and" connector.
- Identify and use the "or" connector.
- Construct truth tables.
- Identify conditional logic statements.
- Identify and use the "If..., then..." connector.
- Identify and use the "...if and only if..." connector.
- Construct truth tables.
- Decipher complex compound logic statements.
- Understand logic arguments.
- Construct truth tables.

2011-312-250 Boolean Algebra . . . . . ---
- Describe basic Boolean operations.
- Describe basic properties of Boolean algebra.
- Describe electronic circuits that perform basic Boolean algebra.
- Describe sum of products equations.
- Describe product of sums equations.
- Describe complements.

2011-312-280 Gate Networks . . . . . ---
- Develop gate networks from sum of products equations.
- Develop gate networks from product of sums equations.
- Find the output of a gate network.
- Develop a truth table for a gate network.

2011-312-310 Simplifying Boolean Equations . . . . . ---
- Review the basic principles of Boolean algebra.
- Describe the rules of Boolean algebra.
- Describe DeMorgan's theorems.
- Use the basic principles, rules, and DeMorgan's theorems to simplify Boolean equations.

2011-312-340 Karnaugh Maps . . . . . ---
- Describe Karnaugh maps.
- Develop a Karnaugh map for two, three, and four variables.

LESSON ID/TITLE CARDS/KITS

MOD 86 - COMPUTER MATH (cont.)

2011-312-340 Karnaugh Maps (cont.)
- Simplify Boolean algebra equations using Karnaugh maps.

2011-312-370 Algorithms and Flowcharts . . . . . ---
- Describe the three basic computer operations.
- Describe algorithms.
- Describe flowcharts.
- Recognize flowchart symbols.

2011-312-400 Sequences and Matrices . . . . . ---
- Define sequences.
- Solve sequence problems.
- Define matrices.
- Solve matrix problems.

2011-312-920 Computer Math Post-Test (Theory) . . . . . ---

MOD 87 - MEASUREMENTS

2011-412-130 Introduction to Linear Measurements . . . . . ---
- Become familiar with the two different standards of measurement.
- Define precision and determine which measurement applications require more or less precision.
- Identify the following measurement tools: standard ruler, micrometer, vernier caliper.
- Define linear measurement.
- Describe how the following measurement tools are used: standard ruler, micrometer, vernier caliper.

2011-412-160 Metric and Scientific Conversions . . . . . ---
- Become familiar with units of British and metric units and be able to convert from one to the other.
- Become familiar with the concepts of scientific notation and be able to add, subtract, multiply, and divide values in scientific notation.

2011-412-190 Angular and Circular Measurements . . . . . ---
- Become familiar with some basic concepts of angular and circular characteristics including: angle, diameter, and radius.
- Describe angular measurement using: try square, carpenter's square, protractor, sliding T-bevel, and combination square.
- Describe diameter and radius measurements using calipers, micrometers, and vernier calipers.

2011-412-220 Area Measurements . . . . . ---
- Define rectangles and squares.
- Determine the difference between the two.
- Use the area formula for squares and rectangles.
- Define parallelograms and triangles.
- Determine the relationship between the two.
- Use the area formula for parallelograms and triangles.
- Define a trapezoid.
- Differentiate trapezoids from parallelograms.
- Define the dimensions of a circle: radius, diameter, and circumference.
- Use the formulas for area and circumference.

LESSON ID/TITLE CARDS/KITS

MOD 87 - MEASUREMENTS (cont.)

2011-412-250 Volume Measurements . . . . . ---
- Define volume and describe how it relates to area.
- Differentiate between liter, centimeter, and meter.
- Solve problems of volume measurement in a solid rectangle.
- Define and be able to recognize a prism.
- Define and be able to recognize a pyramid.
- Using the formulas for each, solve problems of prism and pyramid volume.
- Define and be able to recognize a cylinder.
- Define and be able to recognize a cone.
- Define and be able to recognize a sphere.
- Using the formulas for each, solve problems of cylinder, cone, and sphere volume.

2011-412-280 Velocity and Acceleration Measurements . . . . . ---
- Define vector and scalar quantities and be able to differentiate between the two.
- Define and be able to solve problems of velocity.
- Define and be able to solve problems of acceleration.

2011-412-310 Force Measurements . . . . . ---
- Describe force as it relates to inertia and Newton's First Law of Motion.
- Describe force as it relates to acceleration and Newton's Second Law of Motion.
- Describe force as it relates to interaction and Newton's Third Law of Motion.

2011-412-340 Work and Power Measurements . . . . . ---
- Define work and be able to solve problems using the standard measure of work, the joule (J).
- Define power and be able to solve problems using the standard measure of power, the watt (W).

2011-412-920 Measurements Post-Test (Theory) . . . . . ---

MOD 88 - PHYSICS

3011-212-130 Introduction to Physics . . . . . ---
- Define physics.
- Identify the three states of matter.
- Describe the characteristics of each state.
- Describe how matter can change from one state to another.

3011-212-160 Measurement . . . . . ---
- Describe the purpose of measurements.
- Describe the different types of measurements used by scientists.
- Describe the measurements for length, area, and volume.
- Describe the measurements for mass and density.
- Describe the measurements for time.

3011-212-190 Force . . . . . ---
- Define force and torque.
- Use vectors to represent forces and find resultant forces.
- Define equilibrium of force.
- Discuss Newton's Law of Gravitation.
- Define center of gravity.

3011-212-220 Motion . . . . . ---
- Define motion.

LESSON ID/TITLE CARDS/KITS

MOD 88 - PHYSICS (cont.)

3011-212-220 Motion (cont.)
- Define and calculate velocity and acceleration.
- Discuss Newton's Laws of motion.
- Define the acceleration due to gravity.

3011-212-250 Work and Energy . . . . . ---
- Define work and energy.
- Calculate the work done on an object.
- Define potential and kinetic energy.
- Define power.
- Describe machines.

3011-212-280 Heat . . . . . ---
- Define heat and temperature.
- Describe temperature scales and measurement.
- Describe expansion and contraction.
- Discuss heat transfer by conduction, convection, and radiation.

3011-212-310 Sound and Acoustics . . . . . ---
- Describe sound waves.
- Describe sound wavelength, frequency, and pitch.
- Describe the Doppler effect.
- Define sound intensity.

3011-212-340 Light . . . . . ---
- Define light.
- Describe sources of light.
- Describe reflection and refraction.
- Describe measurement of light.

3011-212-370 Magnetism . . . . . ---
- Define magnetism.
- Describe different types of magnetism.
- Describe relays, motors, and transformers.
- Describe generators.

MOD 89 - CHEMISTRY

3011-112-130 Introduction to Chemistry . . . . . ---
- Define chemistry.
- Describe the history of chemistry.
- Recognize chemistry's impact on everyday life.

3011-112-160 Matter and Energy . . . . . ---
- Define Matter and Energy.
- Name the three states of matter.
- Distinguish classes of matter.
- Differentiate between physical changes and chemical reactions.

3011-112-190 The Periodic Table . . . . . ---
- Recognize the periodic table.
- Understand the structure of the periodic table.
- Identify Groups and Periods.
- Relate various element names to their corresponding chemical symbol.

LESSON ID/TITLE CARDS/KITS

MOD 89 - CHEMISTRY (cont.)

3011-112-190 The Periodic Table (cont.)
- Describe some properties that are common to elements located in the same groups on the periodic table.

3011-112-220 Solids, Liquids, and Gases ---
- Identify the three physical states of matter.
- Define the properties of the three states of matter.
- Understand how matter changes from one state to another.

3011-112-250 Atomic Structure ---
- Describe the structure of the atom.
- Understand how atomic structure gives rise to the chemical properties of the elements.

3011-112-280 Bonding ---
- Understand the process of atomic bonding.
- Distinguish the types of chemical bonds.
- Use the electron dot structure to represent chemical compounds.

3011-112-310 Chemical Quantities ---
- Identify the units of measure used in chemistry.
- Recognize the correct units to use in various chemical calculations.
- Use dimensional analysis for converting chemical quantities and verifying correctness of chemical calculations.

3011-112-340 Chemical Names ---
- Understand and apply standard conventions for naming inorganic chemical compounds.

3011-112-370 Chemical Reactions ---
- Identify different types and classes of chemical reactions.
- Understand the basic mechanisms of chemical reactions.
- Recognize the role of chemical reactions in our day-to-day lives.

3011-112-400 Applications of Chemistry ---
- Identify the impact of some different fields of chemical science on the world today.

MOD 90 - ELECTRICITY AND ELECTRONICS

5014-112-130 Electric Shock and Safety ---
- Identify the characteristics of electric shock.
- Identify the effects of electric shock.
- Define how to prevent electrical hazards.
- Define how to provide treatment for electrical shock.
- Define how to work on an energized circuit.
- Understand the purpose for electrical grounding.
- Understand ground faults and their implications.
- Understand the purpose for over-current protection devices.
- Understand the various types of grounds used in electronic circuits.
- Define ground loop.
- Define electrostatic discharge.
- Understand how to prevent damage from electrostatic discharge.

5014-112-160 Fire, Eye, and Confined Space Safety ---
- Select the correct fire extinguisher to put out a class A, B, C, D, and combination fire.
- Read emergency evacuation route diagrams.
- Implement the 5-point eye safety checklist.

LESSON ID/TITLE CARDS/KITS

MOD 90 - ELECTRICITY AND ELECTRONICS (cont.)

5014-112-160 Fire, Eye, and Confined Space Safety (cont.)
- ▪ Recognize the hazards of confined spaces.

5014-112-190 Tools and Tool Safety . . . . . ---
- ▪ Identify the basic hand tools used for troubleshooting and repair.
- ▪ Describe the types of tasks performed with each tool.
- ▪ Recognize safe procedures concerning tool use.
- ▪ Follow hand and power tool precautions.

5014-112-220 Metric Prefixes and Scientific Notation . . . . . ---
- ▪ Convert decimal numbers to scientific notation and vice versa.
- ▪ Convert decimal numbers to metric prefixes and vice versa.
- ▪ Add, subtract, multiply, and divide powers of ten.
- ▪ Add, subtract, multiply, and divide metric prefixes.

5014-112-250 Introduction to Troubleshooting . . . . . ---
- ▪ Define a System.
- ▪ Recognize differences between components and sub-assemblies.
- ▪ Define Input, Process, and Output as it applies to an Electronic System.
- ▪ Recognize basic troubleshooting techniques.
- ▪ Isolate a faulted device using observation.
- ▪ Selectively replace a faulty device.

5014-112-280 Block Diagrams and Schematics . . . . . ---
- ▪ Recognize the purpose of a block diagram.
- ▪ Use a block diagram to follow signal flow.
- ▪ Identify the basic characteristics of a block diagram.
- ▪ Understand the purpose of a schematic diagram.
- ▪ Understand general concepts concerning schematic diagrams.

5014-112-310 Ohm's Law and Power . . . . . ---
- ▪ Define Ohm's law and describe how voltage, current, and resistance are related.
- ▪ Define power and describe how voltage, current, and Ohm's law are related to power.

5014-112-340 Introduction to Electronics Technology 603
- ▪ Define the terms electricity and electronics.
- ▪ Identify how electronics affects your daily life.
- ▪ State the four groups that comprise the subject of electronics.
- ▪ Define an Electronic System.
- ▪ Recognize differences between components and sub-assemblies.
- ▪ Define Input, Process, and Output as it applies to an Electronic System.
- ▪ Define the Maintenance Process.
- ▪ Apply basic Maintenance Procedures.
- ▪ Recognize the Technicians Role in Maintenance.
- ▫ Observe basic operation of the training console.

MOD 91 - BASIC TEST EQUIPMENT AND CIRCUITS

5014-212-130 Basic Multimeter Measurements 604
- ▪ Identify common multimeter terminology.
- ▪ Recognize the basic parts of a generic multimeter.
- ▪ Describe how to prepare a multimeter for use.
- ▫ Perform voltage measurements with a digital multimeter.

LESSON ID/TITLE CARDS/KITS

MOD 91 - BASIC TEST EQUIPMENT AND CIRCUITS (cont.)

5014-212-130 Basic Multimeter Measurements (cont.)
- ▫ Perform current measurements with a digital multimeter.
- ▫ Perform diode check measurements with a digital multimeter.

5014-212-160 Basic Oscilloscope Measurements 606
- ▪ Describe the purpose of an oscilloscope.
- ▪ Identify the quantities measured by an oscilloscope.
- ▪ Identify different types of oscilloscopes.
- ▫ Identify the four major functional sections of a digital oscilloscope.
- ▫ Describe the purpose of menus and controls.

5014-212-190 Basic Function Generator Operation 605
- ▪ Describe the purpose of a function generator.
- ▪ Identify the types of output signals generated by a function generator.
- ▪ Describe the purpose of each control and switch on a function generator.
- ▫ Set up a Function Generator for normal operation.
- ▫ Adjust a Function Generator for various output signals.

5014-212-220 Direct Current Electricity 603
- ▪ Define the term Direct Current (DC).
- ▪ Identify how direct current affects a circuit.
- ▪ Identify applications that use DC current.
- ▫ Observe the operation of a DC circuit.
- ▫ Perform DC voltage measurements.

5014-212-250 Alternating Current Electricity 613
- ▪ Define the term Alternating Current (AC).
- ▪ Identify how alternating current affects a circuit.
- ▪ Identify appliances that use AC current.
- ▫ Examine the operation of an AC circuit.
- ▫ Perform AC voltage measurements.

5014-212-280 Analog Electronics 623
- ▪ Define the term Analog.
- ▪ Identify how analog affects a circuit.
- ▪ Identify applications that use analog components.
- ▫ Observe the operation of an analog circuit.

5014-212-310 Digital Electronics 633
- ▪ Define the term Digital Electronics.
- ▪ Identify how digital components affect a circuit.
- ▪ Identify appliances that use digital components.
- ▫ Observe the operation of a digital circuit.

MOD 92 - WIRING AND CABLING

5014-214-130 Electrical Wiring Principles . . . . . ---
- ▪ Identify common types of wire and their uses.
- ▪ Describe conductor sizes.
- ▪ Describe types of conductor insulation and color coding.
- ▪ Describe conductor characteristics.
- ▪ Describe common wire installation practices.
- ▪ Identify elements of wire identification.

LESSON ID/TITLE CARDS/KITS

MOD 92 - WIRING AND CABLING (cont.)

5014-214-130 Electrical Wiring Principles (cont.)
- Define wire bundle and wire harness.
- Identify various nationally recognized standards.
- Describe the various methods for securing wire bundles and harnesses.

5014-214-160 Wire Connections and Terminals . . . . . ---
- Identify basic characteristics of wire connections.
- Identify common types of wire connections.
- Define contact resistance.
- Define electrical terminal.
- Identify advantages and disadvantages of types of wire connections.
- Describe causes of common wire connection faults.

5014-214-190 Wire Stripping, Crimping, and Splicing . . . . . ---
- Identify different types of wire strippers and trimmers.
- Identify the proper tools used to strip and trim various wires.
- Understand how to strip wires using wire strippers.
- Identify methods of wire splicing.
- Understand how and when to splice a wire.
- Identify methods of wire soldering.
- Understand how and when to solder wire.
- Identify when and how to crimp wires.
- Identify the proper tools used to crimp various wires.
- Determine the difference between a plug and jack.
- Make a butt splice using proper techniques.

5014-214-220 Basic Soldering Techniques . . . . . ---
- Identify different types of solder and flux.
- Select the correct soldering iron for a particular task.
- Know how to properly prepare a wire for soldering.
- Understand how to make a "Western Union" splice.
- Identify different types of wire terminals and their connection methods.
- Know how to make reliable solder connections.
- Understand how to correct poor solder connections.

5014-214-250 Cable Types and Connectors . . . . . ---
- Describe general cable characteristics.
- Describe the basic parts of a cable.
- Identify the purpose of cable standardization.
- Identify common cable connector types and their purposes.
- Identify common types of cables and their purposes.

MOD 93 - ELECTRONICS APPRENTICE PROGRAM

5014-312-130 Voltage, Current, and Resistance . . . . . ---
- Describe an atom and its structure.
- Define electric charge as it relates to electrons and protons.
- Define electrostatic charge.
- Describe the law of electrostatic force.
- Define voltage.
- Identify the unit of voltage.

LESSON ID/TITLE CARDS/KITS

MOD 93 - ELECTRONICS APPRENTICE PROGRAM (cont.)

5014-312-130 Voltage, Current, and Resistance (cont.)
- Define the relationship between voltage and potential difference.
- Understand chemical action and magnetism as ways of producing voltage.
- Define current, and the ampere as a unit measure for current.
- Describe a conductor and the behavior of electrons within a conductor.
- Describe an insulator and the behavior of the electrons within an insulator.
- Identify the three basic parts of an electrical circuit.
- Describe an electrical circuit load and its relationship to the flow of current.
- Define watt (power) as a unit of work in a circuit.
- Define resistance and the ohm as a unit of measure for resistance.

5014-312-160 Direct Current and DC Resistance . . . . . ---
- Understand the definition of Direct Current (DC).
- Understand the physical application of Direct Current (DC).
- Understand batteries as a source of Direct Current (DC).
- Understand the concept of polarity.
- Understand DC resistance concepts.
- Understand conductivity and non-conductivity from atomic structural view.
- Understand resistors as passive, semi-conductive components.

5014-312-190 Switches and Resistive Devices . . . . . ---
- Identify the purpose of a switch.
- Identify switch schematic symbols.
- Describe Single and Double Pole.
- Describe Single and Double Throw.
- Describe four types of switches.
- Identify the schematic symbol for each switch.
- Identify fixed resistors.
- Identify variable resistors.
- Describe the purpose of a rheostat.
- Describe the purpose of a potentiometer.
- Identify the schematic symbol for rheostats and potentiometers.

MOD 94 - DC CIRCUIT APPLICATIONS

5014-314-130 DC Series Circuits . . . . . ---
- Define what a series circuit is.
- Identify a series circuit.
- Understand the concepts of current and resistance in a series circuit.
- Calculate current and resistance in a series circuit.
- Understand voltage drop concepts.
- Calculate voltage drops across resistance.
- Understand the concepts of voltage series divider circuits.
- Identify a series voltage divider circuit.

5014-314-160 DC Series Circuits Experiment 605
- Calculate and measure resistance in series circuits.
- Calculate and measure voltage in DC series circuits.
- Calculate and measure current values for series circuits.
- Measure the effects of shorts in series circuits.

LESSON ID/TITLE CARDS/KITS

MOD 94 - DC CIRCUIT APPLICATIONS (cont.)

5014-314-160 DC Series Circuits Experiment (cont.)
- ▫ Measure the effect of an open in a series circuit.

5014-314-190 DC Parallel Circuits . . . . . ---
- ▪ Recognize and identify a parallel circuit.
- ▪ Understand how Ohm's law applies in a parallel circuit and the relationships of voltage, current, and resistance.
- ▪ Understand how voltage, current, and resistance react to parallel circuit configurations.
- ▪ Calculate total resistance in a parallel circuit.
- ▪ Calculate total voltage in a parallel circuit.
- ▪ Calculate current in a parallel circuit.

5014-314-220 DC Parallel Circuits Experiment 605
- ▫ Calculate and measure resistance values for parallel circuits.
- ▫ Calculate and measure current values for parallel circuits.
- ▫ Calculate and measure voltage values for parallel circuits.

5014-314-250 DC Series-Parallel Circuits . . . . . ---
- ▪ Identify a series-parallel circuit.
- ▪ Understand how Ohm's Law concepts apply to combination series-parallel circuits.
- ▪ Calculate resistance in a series-parallel circuit.
- ▪ Calculate current in a series-parallel circuit.
- ▪ Calculate voltage in a series-parallel circuit.
- ▪ Understand the concepts of voltage series-parallel divider circuits.

5014-314-280 DC Series-Parallel Circuits Experiment 605
- ▫ Calculate and measure resistance values for series-parallel circuits.
- ▫ Calculate and measure voltage values for series-parallel circuits.
- ▫ Calculate and measure current values for series-parallel circuits.

5014-314-310 Investigating a Resistive System 600, 601, 602
- ▪ Recognize basic circuit components.
- ▪ State general rules associated with basic electronics.
- ▪ Recognize Series, Parallel, and Series-Parallel circuits.
- ▫ Recognize the relationship between a block diagram, schematic, and real circuit.
- ▫ Perform signal and voltage tracing using block diagrams and schematics.
- ▫ Measure signals and perform minor circuit alignments.

5014-314-340 Introduction to Batteries . . . . . ---
- ▪ Describe the basic parts of a battery.
- ▪ Explain the theory of operation of chemical batteries.
- ▪ Define capacity of a battery and how it is measured.
- ▪ Describe the difference between primary batteries and secondary batteries.

5014-314-370 Battery Types and Applications . . . . . ---
- ▪ Describe different types of primary batteries and their applications.
- ▪ Describe different types of secondary batteries and their applications.

MOD 95 - ALTERNATING CURRENT CIRCUITS

5014-412-130 Alternating Current (AC) . . . . . ---
- ▪ Define alternating current.
- ▪ Identify an AC sine wave.
- ▪ Define frequency and cycle.

LESSON ID/TITLE CARDS/KITS

MOD 95 - ALTERNATING CURRENT CIRCUITS (cont.)

5014-412-130 Alternating Current (AC) (cont.)
- Define hertz as a unit of measure for AC frequency.
- Define wavelength of a sine wave.
- Define period of a sine wave.
- Calculate the period of a sine wave.

5014-412-160 Generating Alternating Current (AC) . . . . . ---
- Define magnetism.
- Identify characteristics of magnets.
- Define the characteristics of electromagnetic induction.
- Explain the operation of an AC generator.
- Identify values of voltage and current at various electrical degrees.
- Calculate peak, peak-to-peak, average, and RMS values.
- Identify in and out of phase.

5014-412-190 Non-Sinusoidal Waves . . . . . ---
- Identify harmonic frequencies.
- Identify harmonic frequencies used to produce non-sinusoidal waves.
- Define square waves.
- Identify square wave cycles.
- Describe the difference between square and rectangle waves.

5014-412-220 Resistance in AC Circuits . . . . . ---
- Use Ohm's law to determine resistance in an AC series circuit.
- Identify the relationship between voltage, current, and resistance in an AC series circuit.
- Use Ohm's law to determine resistance in an AC parallel circuit.
- Identify the relationship between voltage, current, and resistance in an AC parallel circuit.
- Use Ohm's law to determine resistance in an AC series-parallel circuit.
- Identify the relationship between voltage, current, and resistance in an AC series-parallel circuit.

MOD 96 - ELECTRONICS APPRENTICE PROGRAM

5014-414-130 Capacitors . . . . . ---
- Identify types of capacitors.
- Describe charge and discharge characteristics of a capacitor.
- Identify the schematic symbol for a capacitor.
- Define capacitive reactance.
- Define impedance in a circuit with capacitance.
- Identify the unit of measurement for capacitance.
- Explain the effects of a capacitor failure on a system.
- Identify ceramic, film, mica, and electrolytic capacitors.
- Read the capacitance and voltage values.

5014-414-160 Inductors . . . . . ---
- Identify types of inductors.
- Describe the current opposing characteristic of an inductor.
- Identify the schematic symbol for an inductor.
- Define inductive reactance.
- Define impedance.
- Identify the unit of measurement for inductance.

LESSON ID/TITLE CARDS/KITS

MOD 96 - ELECTRONICS APPRENTICE PROGRAM (cont.)

5014-414-160 Inductors (cont.)
- ▪ Explain the effects of an inductor failure on a system.
- ▪ Identify inductor types.
- ▪ Identify inductor values.

5014-414-190 Diodes . . . . . ---
- ▪ Identify the purpose of a diode.
- ▪ Recognize the common types of diodes.
- ▪ Recognize diode schematic symbols and reference designators.
- ▪ Describe the uses of diodes.
- ▪ Describe semiconductor material.
- ▪ Describe P and N-type semiconductor material.
- ▪ Describe forward and reverse biasing.

5014-414-220 Transformers . . . . . ---
- ▪ Describe the purpose of transformers.
- ▪ Identify transformer schematic symbols and the reference designation.
- ▪ Describe transformer operating characteristics.
- ▪ Define turns ratio.
- ▪ Define step-up and step-down transformers.
- ▪ Understand the relationship between primary and secondary current and voltages.

5014-414-250 Introduction to AC Circuits 610, 611, 612
- ▪ Examine the function of step-up and step-down transformers.
- ▫ Identify the operation of a Half-Wave Power Supply circuit.
- ▫ Trace signal flow using schematics.
- ▫ Trace signal flow using test equipment.

5014-414-280 AC Signal Generation and Filters 610, 611, 612
- ▪ Define an active and passive filter.
- ▪ Define a low-pass filter.
- ▪ Define a high-pass filter.
- ▪ Define a band-pass filter.
- ▪ Define a band-reject filter.
- ▫ Calibrate signal provided by the signal generator.
- ▫ Observe low-pass and high-pass filters.
- ▫ Observe band-pass and notch filters.

MOD 97 - POWER SUPPLIES

5014-416-130 AC-DC Power Supply . . . . . ---
- ▪ Explain the purpose of the DC power supply.
- ▪ Describe the sections of a typical linear power supply.
- ▪ Describe the differences between a linear and a switched-mode power supply.
- ▪ Discuss the advantages and disadvantages of a switched-mode power supply.
- ▪ Identify half-wave rectifiers.
- ▪ Identify full-wave rectifiers.
- ▪ Identify bridge rectifiers.
- ▪ Identify power supply filter circuits.
- ▪ Describe basic filter operating characteristics.
- ▪ Identify series and parallel voltage regulator circuits.

LESSON ID/TITLE CARDS/KITS

MOD 97 - POWER SUPPLIES (cont.)

5014-416-130 AC-DC Power Supply (cont.)
- Describe operating characteristics of series voltage regulators.
- Describe operating characteristics of parallel voltage regulators.

5014-416-160 AC-DC Power Supply Operation 607
- Observe normal half-wave and full-wave rectifier operation based on signal measurements.
- Observe normal filter circuit operation based on signal measurements.
- Observe normal voltage regulator operation based on signal measurements.

MOD 98 - ANALOG CIRCUITS

5014-512-130 Junction Diodes . . . . . ---
- Describe the purpose of a junction diode.
- Identify the schematic symbol for a junction diode.
- Describe forward and reverse bias.
- Calculate circuit current based on the knee voltage of the diode.

5014-512-160 Special Purpose Diodes . . . . . ---
- Identify the zener diode schematic symbol.
- Identify the purpose of the zener diode.
- Describe the operation of the zener diode.
- Identify the schematic symbols of special purpose diodes.
- Identify the purpose of special purpose diodes.
- Describe the operation of special purpose diodes.

5014-512-190 Diode Operation 620, 621, 622
- Observe normal junction diode operation based on voltage measurements.
- Observe normal zener diode operation based on voltage measurements.
- Observe light emitting diode operation using voltage measurements.

5014-512-220 Introduction to Transistors . . . . . ---
- Describe the purpose of a transistor.
- Describe types of transistors.
- Identify transistor schematic symbols.
- Identify leads on transistors.

5014-512-250 Basic Transistor Operation 620, 621, 622
- Observe normal operation of an NPN and PNP transistor using voltage measurements.

5014-512-280 JFETs and MOSFETs . . . . . ---
- Recognize field effect transistor schematic symbols.
- Describe the construction of field effect transistors.
- Describe operating characteristics of field effect transistors.
- Recognize Metal-Oxide Semiconductor Field Effect Transistor (MOSFET) schematic symbols.
- Describe the construction of MOSFET devices.
- Describe the operation of Depletion-mode MOSFETs.
- Describe the operation of Enhancement-mode MOSFETs.
- Identify various MOSFET device applications.

MOD 99 - ANALOG CIRCUIT APPLICATIONS

5014-514-130 Introduction to Analog Circuits 620, 621, 622
- Recognize the operations of a bridge rectifier.

LESSON ID/TITLE CARDS/KITS

MOD 99 - ANALOG CIRCUIT APPLICATIONS (cont.)

5014-514-130 Introduction to Analog Circuits (cont.)
- ▪ Recognize the operation of discrete, variable, and fixed power supplies.
- ▪ Recognize the operation of a crystal-controlled oscillator.
- ▪ Recognize the operation of an IC amplifier.
- ▫ Investigate the operation of power supplies, oscillators, and amplifier circuits.

MOD 100 - DIGITAL CIRCUITS

5014-612-130 Solid State Switches . . . . . ---
- ▪ Define breakover voltage.
- ▪ Describe the basic characteristics of four-layer devices.
- ▪ Define holding current.
- ▪ Describe the purpose of a silicon-controlled rectifier.
- ▪ Identify the silicon-controlled rectifier schematic symbol.
- ▪ Describe the operating characteristics of silicon-controlled rectifiers.
- ▪ Describe the relationship between triacs and SCRs.
- ▪ Recognize triac circuit operation based on input conditions.
- ▪ Explain how a diac is used with a triac.

5014-612-160 Integrated Circuits . . . . . ---
- ▪ Define integrated circuit.
- ▪ Identify integration classifications.
- ▪ Understand the various IC packaging types.
- ▪ Understand markings associated with integrated circuits.
- ▪ Identify basic IC packaging materials.
- ▪ Identify the purpose of the IC Data Book and Technical Guide and Cross Reference book.

5014-612-190 Basic Concepts of Microprocessors and Microcontrollers . . . . . ---
- ▪ Understand the terms associated with microprocessors.
- ▪ Define microprocessor.
- ▪ Define microcontroller.
- ▪ Describe the basic parts of a microprocessor.

5014-612-220 Analog Switches and Multiplexers . . . . . ---
- ▪ Compare the analog switch to other switching methods.
- ▪ Discuss basic characteristics of analog switch operation.
- ▪ Discuss basic characteristics of analog multiplexer operation.
- ▪ Discuss basic characteristics of analog demultiplexer operation.

5014-612-250 Operational Amplifiers 630, 631, 632
- ▪ Describe operational amplifiers.
- ▪ Describe the types of circuits used in an operational amplifier.
- ▪ Describe the basic construction of IC operational amplifiers.
- ▪ Describe linear operational amplifiers.
- ▪ Describe arithmetic operational amplifiers.
- ▪ Describe comparator operational amplifiers.
- ▫ Observe normal operation of an operational amplifier by making signal measurements.

MOD 101 - DIGITAL CIRCUIT APPLICATIONS

5014-614-130 Introduction to Digital 630, 631, 632
- ▪ Identify the purpose of a signal generator.

LESSON ID/TITLE CARDS/KITS

MOD 101 - DIGITAL CIRCUIT APPLICATIONS (cont.)

5014-614-130 Introduction to Digital (cont.)
- ▪ Identify the purpose of a binary counter.
- ▪ Trace signal flow using block diagrams.
- ▫ Trace signal flow using system schematics.
- ▫ Monitor signal developed by a signal generator.
- ▫ Align signal generator in accordance with (IAW) procedure.

5014-614-160 A/D and D/A Conversion 630, 631, 632
- ▪ Identify the A/D conversion process.
- ▪ Identify the D/A conversion process.
- ▫ Analyze 8-bit A/D circuitry.
- ▫ Analyze 8-bit D/A circuitry.

5014-614-190 Digital Gates 630, 631, 632
- ▪ Identify digital logic schematic symbols.
- ▪ Identify digital logic gate operation.
- ▪ Analyze digital gate truth tables.
- ▫ Measure input and output waveforms.

5014-614-220 Digital Flip-Flops 630, 631, 632
- ▪ Understand basic flip-flop operation.
- ▪ Predict inputs and outputs of a D-type flip-flop.
- ▫ Measure the normal operation of a D-type flip-flop.
- ▫ Recognize outputs of a D-type flip-flop.

MOD 102 - ELECTROMECHANICAL DEVICES

5014-712-130 Overcurrent and Overvoltage Protection Devices . . . . . ---
- ▪ Define current limiting.
- ▪ Understand the purpose of fuses.
- ▪ Understand the purpose of circuit breakers.
- ▪ Identify schematic symbols for fuses and circuit breakers.
- ▪ Identify the causes of voltage spikes or surges.
- ▪ Understand the purpose of voltage surge protection devices.
- ▪ Describe voltage spike.
- ▪ Describe voltage surge.
- ▪ Describe the three main characteristics of voltage surge protection devices.

5014-712-160 Electromagnetism and Electromagnetic Devices . . . . . ---
- ▪ Define electromagnetism.
- ▪ Identify characteristics of electromagnets.
- ▪ Describe the basic operation of a relay.
- ▪ Describe the basic operation of a magnetic breaker.
- ▪ Describe the basic operation of a meter.

5014-712-190 Relays and Solenoids 608
- ▪ Describe the purpose and types of relays.
- ▪ Describe basic relay construction and operation.
- ▪ Identify the schematic symbol and reference designator for relays.
- ▪ Describe the latched and time delay relay.
- ▪ Describe the basic operation and construction of a solenoid.
- ▪ Identify the purpose for a solenoid.

LESSON ID/TITLE — CARDS/KITS

MOD 102 - ELECTROMECHANICAL DEVICES (cont.)

5014-712-190 Relays and Solenoids (cont.)
- ▪ Identify the schematic symbol of a solenoid.
- ▫ Observe normal relay and solenoid operation based on voltage signal tracing.

5014-712-220 DC Motor Principles . . . . . ---
- ▪ Describe the basic principles of DC motor operation.
- ▪ Describe the three different connections for brush DC motors.
- ▪ Identify the schematic symbol for the DC motor.
- ▪ Identify the physical characteristics of BLDC motors.
- ▪ Describe the advantages of BLDC over other types.
- ▪ Understand basic BLDC types and applications.

5014-712-250 Transducers . . . . . ---
- ▪ Define transducer.
- ▪ Identify types of transducers.
- ▪ Understand transducer operating principles.

5014-712-280 PWM Switching Power Supplies 670, 671, 672
- ▪ Observe operation of the switching power supply using block diagrams.
- ▪ Trace the operation of the switching power using schematics.
- ▫ Adjust the switching power supply circuit.

Notes:

* Cards must be purchased separately.

NOTES

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