



**NIDA CORPORATION
COMPUTER ASSISTED INSTRUCTION**

LESSON AND OBJECTIVE LISTING

Master Course Listing

2020-03-20

OBJECTIVE LISTING - Master Course Listing

TABLE OF CONTENTS

THEORY - GENERAL

MOD 0 - INTRODUCTION 1

MODEL 1401 - DC CIRCUITS

MOD 1 - INTRODUCTION TO ELECTRICITY 1

MOD 2 - MULTIMETER MEASUREMENTS 2

MOD 3 - BASIC DC CIRCUITS 3

MOD 4 - COMPLEX DC CIRCUITS 5

MOD 5 - WIRING 6

MODEL 1402 - AC CIRCUITS

MOD 6 - INTRODUCTION TO AC CIRCUITS 7

MOD 7 - AC TEST EQUIPMENT 8

MOD 8 - INDUCTANCE AND RL CIRCUITS 9

MOD 9 - CAPACITANCE AND RC CIRCUITS 10

MOD 10 - RC TIME CONSTANTS AND TRANSIENTS 12

MOD 11 - RESONANCE 12

MOD 12 - TRANSFORMERS 13

MOD 13 - RELAYS AND SWITCHES 14

MODEL 1403 - ANALOG CIRCUITS

MOD 14 - DIODE AND DIODE CIRCUITS 15

MOD 15 - TRANSISTOR CIRCUITS 16

MOD 16 - POWER SUPPLIES 17

MOD 17 - TRANSISTOR AMPLIFIERS 19

MOD 18 - TRANSISTOR OSCILLATORS 20

MOD 19 - TRANSISTOR PULSE AMPLIFIERS 22

MOD 20 - TRIGGER DEVICE CIRCUITS 23

MOD 21 - OPERATIONAL AMPLIFIERS 24

MOD 22 - INTRODUCTION TO RF CIRCUITS 25

MOD 23 - SWITCHING POWER DEVICES 25

MODEL 2105 - DIGITAL CIRCUITS

MOD 24 - INTRODUCTION TO DIGITAL CIRCUITS 26

MOD 25 - DIGITAL LOGIC FUNCTIONS 27

MOD 26 - COMBINATIONAL LOGIC CIRCUITS 28

MOD 27 - FLIP-FLOP CIRCUITS 29

MOD 28 - REGISTER MEMORY CIRCUITS 30

MOD 29 - ARITHMETIC COUNTING CIRCUITS 30

MOD 30 - CONVERSION AND DATA CIRCUITS 31

MODEL 1439 - 8051 MICROCONTROLLER

MOD 31 - MICROCONTROLLER (8051) 32

MODEL 1441 - 8085/8086 MICROPROCESSOR

MOD 32 - MICROPROCESSOR (8085/8086) 33

MODEL 1468 - 68000 MICROPROCESSOR

MOD 33 - MICROPROCESSOR (68000) 34

MODEL 1418 - INTRODUCTION TO FILTERS

MOD 34 - FILTERS 36

MODEL 1413 - CIRCUIT CONSTRUCTION

MOD 35 - CIRCUIT CONSTRUCTION 37

MODEL 1410 - SOLDERING

MOD 36 - SOLDERING (LEAD) 38

OBJECTIVE LISTING - Master Course Listing

TABLE OF CONTENTS (cont.)

<u>MODEL 1409 - SOLDERING LF</u>	
MOD 37 - LEAD-FREE SOLDERING	40
<u>MODEL 1459 - CABLES AND CONNECTORS</u>	
MOD 38 - CABLES AND CONNECTORS	43
<u>MODEL 1405 - TRANSDUCERS</u>	
MOD 39 - TRANSDUCER SYSTEMS	45
<u>MODEL 1432 - BASIC MOTORS</u>	
MOD 40 - INTRODUCTION TO MOTORS	46
<u>MODEL 170 - MOTOR CONTROL SYSTEMS</u>	
MOD 41 - MOTOR CONTROL SYSTEMS	47
<u>THEORY - SYNCHRO/SERVO</u>	
MOD 42 - SYNCHRO SERVO SYSTEMS	49
<u>THEORY - HYDRAULICS/PNEUMATICS</u>	
MOD 43 - HYDRAULIC AND PNEUMATIC SYSTEMS	49
<u>MODEL 5050 - PROGRAMMABLE LOGIC CONTROLLERS (PLCS)</u>	
MOD 44 - PROGRAMMABLE LOGIC CONTROLLERS	50
<u>MODEL 1407 - SIGNAL PROCESSING</u>	
MOD 45 - SIGNAL PROCESSING	53
<u>MODEL 1436 - TELECOMMUNICATIONS</u>	
MOD 46 - TELECOMMUNICATIONS	57
<u>MODEL 4444 - RF COMMUNICATIONS</u>	
MOD 47 - RF COMMUNICATIONS	58
<u>MODEL 1406 - FIBEROPTICS</u>	
MOD 48 - FIBEROPTIC CIRCUITS	60
<u>MODEL 3341 - BASIC MICROWAVE</u>	
MOD 49 - BASIC MICROWAVE	61
<u>MODEL 1415 - SEARCH RADAR</u>	
MOD 50 - BASIC RADAR SYSTEMS	62
<u>MODEL 1438G - FUNDAMENTALS OF AVIATION</u>	
MOD 51 - INTRODUCTION TO AVIATION MAINTENANCE TECHNOLOGY	63
MOD 52 - AIRCRAFT PUBLICATIONS	64
MOD 53 - LINE MAINTENANCE	65
<u>MODEL 1438P - AIRCRAFT ELECTRICAL</u>	
MOD 54 - AIRCRAFT WIRING	65
MOD 55 - AIRCRAFT POWER	66
<u>MODEL 1438S - AIRCRAFT ELECTRICAL SYSTEMS</u>	
MOD 56 - AIRCRAFT AIRFRAME SYSTEMS	67
<u>MODEL 1438E - AIRCRAFT ELECTRONIC SYSTEMS</u>	
MOD 57 - AIRCRAFT INSTRUMENT SYSTEMS	68
MOD 58 - AIRCRAFT COMMUNICATIONS SYSTEMS	69
MOD 59 - AIRCRAFT NAVIGATION SYSTEMS	70
<u>MODEL 1438D - AVIONICS DATA COMMUNICATIONS</u>	
MOD 60 - AVIONICS DATA COMMUNICATIONS	70
<u>MODEL 1431A - AUTOMOTIVE ELECTRONICS</u>	
MOD 61 - INTRODUCTION TO VEHICLE TECHNOLOGY	72
MOD 62 - INTRODUCTION TO AUTOMOTIVE ELECTRICITY	73
MOD 63 - AUTOMOTIVE TEST EQUIPMENT	73
MOD 64 - BASIC ELECTRICAL DC AND AC	74

OBJECTIVE LISTING - Master Course Listing

TABLE OF CONTENTS (cont.)

MOD 65 - BASIC ELECTRONICS FOR AUTOMOTIVE	76
MOD 66 - BASIC AUTOMOTIVE SYSTEMS	77
MOD 67 - CAN BUS	78
<u>THEORY - RESIDENTIAL WIRING</u>	
MOD 69 - INTRODUCTION TO RESIDENTIAL WIRING	80
MOD 70 - ROOM BRANCH CIRCUITS	80
MOD 71 - SPECIAL PURPOSE BRANCH CIRCUITS	81
<u>MODEL 7000 - INDUSTRIAL</u>	
MOD 74 - COMMERCIAL WIND ENERGY SYSTEMS	82
MOD 75 - COMMERCIAL SOLAR ENERGY SYSTEMS	83
MOD 76 - POWER DISTRIBUTION	84
MOD 77 - AC MOTORS	85
MOD 78 - INTRO TO PROCESS AUTOMATION	86
MOD 79 - INSTRUMENTATION	87
MOD 80 - CONTROLLERS	88
MOD 81 - INTEGRATION	88
<u>THEORY - MATH</u>	
MOD 82 - BASIC MATHEMATICS	89
MOD 83 - ALGEBRA	90
MOD 84 - TRIGONOMETRY	92
MOD 85 - CALCULUS	94
MOD 86 - COMPUTER MATH	95
MOD 87 - MEASUREMENTS	97
<u>THEORY - PHYSICS</u>	
MOD 88 - PHYSICS	98
<u>THEORY - CHEMISTRY</u>	
MOD 89 - CHEMISTRY	99
<u>MODEL 1600 - ELECTRONICS APPRENTICE PROGRAM</u>	
MOD 90 - ELECTRICITY AND ELECTRONICS	100
MOD 91 - BASIC TEST EQUIPMENT AND CIRCUITS	101
MOD 92 - WIRING AND CABLING	102
MOD 93 - ELECTRONICS APPRENTICE PROGRAM	103
MOD 94 - DC CIRCUIT APPLICATIONS	104
MOD 95 - ALTERNATING CURRENT CIRCUITS	105
MOD 96 - ELECTRONICS APPRENTICE PROGRAM	106
MOD 97 - POWER SUPPLIES	107
MOD 98 - ANALOG CIRCUITS	108
MOD 99 - ANALOG CIRCUIT APPLICATIONS	108
MOD 100 - DIGITAL CIRCUITS	109
MOD 101 - DIGITAL CIRCUIT APPLICATIONS	109
MOD 102 - ELECTROMECHANICAL DEVICES	110

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 3 - BASIC DC CIRCUITS (cont.)

<p>5021-116-160 Series Circuits (cont.)</p> <ul style="list-style-type: none"> ▪ 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. 	---
<p>5021-116-190 Series Circuit Troubleshooting Theory</p> <ul style="list-style-type: none"> ▪ 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. 	---
<p>5021-116-220 Series Circuit Troubleshooting Experiment</p> <ul style="list-style-type: none"> ▫ 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. 	6A
<p>5021-116-250 Series Circuit Troubleshooting Practice</p> <ul style="list-style-type: none"> ▫ 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. 	6A
<p>5021-116-280 Parallel Circuits</p> <ul style="list-style-type: none"> ▪ 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. 	8A
<p>5021-116-310 Parallel Circuit Troubleshooting Theory</p> <ul style="list-style-type: none"> ▪ Identify an open, short, and changed value component in a parallel circuit. ▪ Analyze a parallel circuit and determine if the circuit is defective. 	---
<p>5021-116-340 Parallel Circuit Troubleshooting Experiment</p> <ul style="list-style-type: none"> ▫ 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. 	8A
<p>5021-116-370 Parallel Circuit Troubleshooting Practice</p> <ul style="list-style-type: none"> ▫ 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. 	8A
<p>5021-116-400 Series-Parallel Circuits</p> <ul style="list-style-type: none"> ▪ 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. 	9A

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

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.	

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 8 - INDUCTANCE AND RL CIRCUITS (cont.)

5021-316-190 RL Series Circuits	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▫ 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
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▫ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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*
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▪ Identify types of capacitors. 	

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 9 - CAPACITANCE AND RC CIRCUITS (cont.)

5021-318-130 Introduction to Capacitors (cont.)	11
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▫ Identify ceramic, film, mica, and electrolytic capacitors. ▫ Read the capacitance and voltage values. 	
5021-318-190 RC Series Circuits	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▫ 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
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▫ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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*
<ul style="list-style-type: none"> ▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions. 	

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 12 - TRANSFORMERS (cont.)

5021-324-130 Introduction to Transformers (cont.)	21
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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*
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ Trace signal flow through a relay circuit. ▪ Measure voltages in a relay circuit. 	
5021-326-190 Troubleshooting Relays and Switches	84B
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ Trace signal flow through an electrical circuit. ▪ Measure AC and DC voltages in an electrical circuit. 	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 15 - TRANSISTOR CIRCUITS (cont.)

5021-516-190 Introduction to Transistor Amplifiers	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▫ 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*
<ul style="list-style-type: none"> ▫ 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

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 16 - POWER SUPPLIES (cont.)

<p>5021-518-130 Introduction to Power Supplies and Diode Rectifiers</p> <ul style="list-style-type: none"> ▪ 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. 	<p>---</p>
<p>5021-518-160 Full- and Half-Wave Rectifier Operation</p> <ul style="list-style-type: none"> ▪ 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. 	<p>23</p>
<p>5021-518-190 Bridge Rectifier Operation</p> <ul style="list-style-type: none"> ▪ 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. 	<p>24</p>
<p>5021-518-220 Introduction to Voltage Regulators</p> <ul style="list-style-type: none"> ▪ 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. 	<p>---</p>
<p>5021-518-250 Zener Diode Operation</p> <ul style="list-style-type: none"> ▪ 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. 	<p>22B</p>
<p>5021-518-280 Zener Diode Regulator Operation</p> <ul style="list-style-type: none"> ▪ 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. 	<p>23, 25</p>
<p>5021-518-310 Voltage Regulator Operation</p> <ul style="list-style-type: none"> ▪ 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. 	<p>23, 26</p>
<p>5021-518-340 Voltage Regulator Troubleshooting Experiment</p> <ul style="list-style-type: none"> ▪ Describe typical faults in voltage regulator circuits. ▪ Describe voltage regulator troubleshooting procedures. ▫ Recognize that a zener diode voltage regulator circuit is faulted. 	<p>23, 25, 26</p>

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 21 - OPERATIONAL AMPLIFIERS (cont.)

5041-118-160 Operational Amplifier Experiment	161, 162, 163
<ul style="list-style-type: none"> ▫ 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*
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▫ Recognize AM receiver circuits. ▫ Describe the operating characteristics of AM receiver circuits. 	
5021-530-200 AM Receiver Troubleshooting	---
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▫ 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
<ul style="list-style-type: none"> ▫ 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. 	

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 23 - SWITCHING POWER DEVICES (cont.)

5021-612-190 Metal-Oxide Semiconductor Field Effect Transistor (MOSFET)	551
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ Describe the purpose of the 555 timer. 	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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 $\sim R\sim S$ latches.
 - Identify the RS and $\sim R\sim S$ latch truth tables.
 - Describe the race condition in the RS and $\sim R\sim S$ 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 $\sim R\sim S$ flip-flop.
 - Verify the inputs and outputs of the RS and $\sim R\sim S$ flip-flops.
 - Understand the basic principles of the RS and $\sim R\sim S$ 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.

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE	CARDS/KITS
<u>MOD 31 - MICROCONTROLLER (8051) (cont.)</u>	
5082-222-190 Interfacing with the 8051 Microcontroller	405, 406, 407
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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)	---
<u>MOD 32 - MICROPROCESSOR (8085/8086)</u>	
5082-212-130 Introduction to Microprocessors	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ Describe the internal structure of the 8086 microprocessor. ▪ Understand the various internal components. ▪ Understand the external connections to the 8086. 	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 33 - MICROPROCESSOR (68000) (cont.)

5082-228-280 Introduction to Programming	401, 403, 404, 468
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ Describe the operation of high-pass filters. ▪ Describe the types of high-pass filters. ▪ Calculate high-pass filter circuit values. 	

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE	CARDS/KITS
MOD 35 - CIRCUIT CONSTRUCTION (cont.)	
5021-912-250 Digital Circuit Construction	130X
<ul style="list-style-type: none"> ▫ Construct a digital circuit. ▫ Verify digital circuit operation. 	
MOD 36 - SOLDERING (LEAD)	
5021-914-130 Soldering Safety and Electrostatic Sensitive Devices	---
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▫ Use safety equipment properly. ▫ Demonstrate how to tin a soldering iron tip properly. 	
5021-914-190 Wire Stripping, Tinning, and Splicing	---
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▫ 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	---
<ul style="list-style-type: none"> ▫ Understand the IPC/EIA J-STD-001C standards used for turret, bifurcated, and hook terminals. 	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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, SFTP, 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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 40 - INTRODUCTION TO MOTORS (cont.)

5142-312-160 DC Motors and Generators	180
<ul style="list-style-type: none"> ▪ Describe the operation of DC motors. ▪ Describe the operation of DC generators. ▫ Observe the normal operation of a DC motor-generator set. ▫ Measure signals in the control circuits for a DC motor-generator set. ▫ Troubleshoot a DC motor-generator set. 	
5142-312-190 Stepper Motors	181
<ul style="list-style-type: none"> ▪ Describe the operation of stepper motors. ▪ Describe the characteristics of stepper motors. ▫ Observe the normal operation of stepper motors. ▫ Measure signals in the control circuits for stepper motors. ▫ Troubleshoot stepper motors. 	
5142-312-220 AC Motors and Generators	---
<ul style="list-style-type: none"> ▪ Describe motor theory of operation. ▪ Describe AC motor construction. ▪ Discuss terms and types of AC motors. ▪ Discuss the equivalent model of an induction motor transformer. ▪ Discuss general AC generator theory. ▪ Describe generator construction. ▪ Describe generator characteristics. 	

MOD 41 - MOTOR CONTROL SYSTEMS

5142-314-130 DC Series Field Motors	---
<ul style="list-style-type: none"> ▪ Identify the principles and types of rotating machinery (motors). ▪ Describe basic DC motor action. ▪ Describe the DC series field motor. ▪ Identify the principles of circular force and torque. ▪ Describe the characteristics of a DC series field motor. ▪ Identify the loaded characteristics of a DC series field motor. 	
5142-314-160 Brushless DC Motors	---
<ul style="list-style-type: none"> ▪ Identify the physical characteristics of BLDC motors. ▪ Describe the advantages of BLDC over other types. ▪ Understand basic BLDC types, applications, and configurations. ▪ Describe motor drive, position sensing, and other controller functions. 	
5142-314-190 Troubleshooting AC Motors	---
<ul style="list-style-type: none"> ▪ Describe safety issues related to motor troubleshooting. ▪ Describe routine maintenance on motors. ▪ Describe a visual check of a motor. ▪ Describe an operational check and a performance test. 	
5142-314-220 Pulse Width Modulation and Amplification	178, 179
<ul style="list-style-type: none"> ▪ Identify the principles of pulse width modulation. ▪ Describe the operation of PWM motor control. ▪ Describe the operation of a PWM amplifier/driver. ▫ Measure signals at various points throughout a PWM circuit. ▫ Measure and compare pulse width vs. current output of a PWM amplifier. ▫ Recognize normal operation of a PWM motor driver. 	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 45 - SIGNAL PROCESSING (cont.)

5101-128-130	Phase Shift Keying (PSK)	---
	<ul style="list-style-type: none"> ▪ 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
	<ul style="list-style-type: none"> ▫ 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
	<ul style="list-style-type: none"> ▫ 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)	---
	<ul style="list-style-type: none"> ▪ 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
	<ul style="list-style-type: none"> ▫ 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
	<ul style="list-style-type: none"> ▫ 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)	---
	<ul style="list-style-type: none"> ▪ 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
	<ul style="list-style-type: none"> ▫ 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
	<ul style="list-style-type: none"> ▫ 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)	---

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 46 - TELECOMMUNICATIONS

5102-312-130	Introduction to Communications Systems	---
	<ul style="list-style-type: none"> ▪ 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	---
	<ul style="list-style-type: none"> ▪ 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
	<ul style="list-style-type: none"> ▪ 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	---
	<ul style="list-style-type: none"> ▪ 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	---
	<ul style="list-style-type: none"> ▪ 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	---
	<ul style="list-style-type: none"> ▪ Identify innovators in the telecommunications industry. ▪ Describe a brief history of telecommunications. 	
5102-314-220	Special Interest Groups	---
	<ul style="list-style-type: none"> ▪ Describe special interest groups in the telecommunications industry. 	
5102-314-250	Telecommunications Terminology	---
	<ul style="list-style-type: none"> ▪ 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	---
	<ul style="list-style-type: none"> ▪ 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. 	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 50 - BASIC RADAR SYSTEMS (cont.)

5061-212-220 Transmission Lines	---
<ul style="list-style-type: none"> ▪ Identify transmission line operating characteristics. ▪ Identify the different types of transmission lines. 	
5061-212-250 Waveguide Theory	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ Understand antenna characteristics. ▪ Explain the propagation of energy in antennas. 	
5061-212-310 Cavity Resonators and Tube Microwave Devices	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▪ 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. 	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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) ---

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE	CARDS/KITS
<u>MOD 64 - BASIC ELECTRICAL DC AND AC (cont.)</u>	
7021-216-920 Basic Electrical DC and AC Post-Test (Theory)	---
<u>MOD 65 - BASIC ELECTRONICS FOR AUTOMOTIVE</u>	
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.	

OBJECTIVE LISTING - Master Course Listing

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.	

OBJECTIVE LISTING - Master Course Listing

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, 720HARNESSES

- 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.

OBJECTIVE LISTING - Master Course Listing

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) ---

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 77 - AC MOTORS (cont.)

7272-414-250 Capacitor Start Motors	650, 651, 652	
<ul style="list-style-type: none"> ▪ 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	
<ul style="list-style-type: none"> ▪ 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	
<ul style="list-style-type: none"> ▪ 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	
<ul style="list-style-type: none"> ▪ 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	
<ul style="list-style-type: none"> ▪ 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	
<ul style="list-style-type: none"> ▪ 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	
<ul style="list-style-type: none"> ▪ 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		---
<ul style="list-style-type: none"> ▪ 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		---
<ul style="list-style-type: none"> ▪ Identify basic characteristics found on control diagrams. 		

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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

OBJECTIVE LISTING - Master Course Listing

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 standards TIA-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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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 $X \times A = B$ type of equations.
 - Solve $X \div A = B$ 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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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 arcsecant, arccosecant, and arccotangent.
 - Solve problems involving arcsecant, arccosecant, 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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

LESSON ID/TITLE

CARDS/KITS

MOD 91 - BASIC TEST EQUIPMENT AND CIRCUITS (cont.)

5014-212-130 Basic Multimeter Measurements (cont.)	606
▫ 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.	

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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.

OBJECTIVE LISTING - Master Course Listing

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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