



**NIDA CORPORATION
COMPUTER ASSISTED INSTRUCTION**

LESSON AND OBJECTIVE LISTING

**Master Course Listing
Basic Electronics**

2018-09-11

Representative



Technology Education Concepts
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OBJECTIVE LISTING - Master Course Listing

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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.

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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.

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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.	

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MOD 3 - BASIC DC CIRCUITS (cont.)

5021-116-160 Series Circuits (cont.)	
▪ Calculate current in a series circuit.	
▪ Calculate voltage drops across resistance.	
▫ Measure current values in a series circuit.	
▫ Measure voltage drops in a series circuit.	
5021-116-190 Series Circuit Troubleshooting Theory	---
▪ Follow a logical troubleshooting procedure.	
▪ Identify an open, short, and a changed value component in a series circuit.	
▪ Analyze a series circuit and determine if the circuit is defective.	
5021-116-220 Series Circuit Troubleshooting Experiment	6A
▫ Determine if a series circuit is open and identify which component is open.	
▫ Determine if a series circuit has a short and identify which component is shorted.	
▫ Determine if a series circuit has a changed value and identify which resistor has a changed value.	
5021-116-250 Series Circuit Troubleshooting Practice	6A
▫ Troubleshoot a series circuit and identify if the circuit is operating properly.	
▫ Identify a faulted circuit as being open, shorted, or changed value.	
▫ Identify the component most likely to cause the fault.	
5021-116-280 Parallel Circuits	8A
▪ Identify a parallel circuit.	
▪ Recognize that the applied voltage is the same across each branch.	
▪ Calculate current in each branch of a parallel circuit.	
▪ Calculate total current from the sum of the individual branches of a parallel circuit.	
▪ Calculate total resistance in a parallel circuit.	
▫ Measure the applied voltage across each branch in a parallel circuit.	
▫ Measure current across each branch in a parallel circuit.	
▫ Measure total resistance in a parallel circuit.	
5021-116-310 Parallel Circuit Troubleshooting Theory	---
▪ Identify an open, short, and changed value component in a parallel circuit.	
▪ Analyze a parallel circuit and determine if the circuit is defective.	
5021-116-340 Parallel Circuit Troubleshooting Experiment	8A
▫ Determine if a parallel circuit is open and identify which component is open.	
▫ Determine if a parallel circuit has a short and identify which component is shorted.	
▫ Determine if a parallel circuit has a changed value and identify which resistor has changed value.	
5021-116-370 Parallel Circuit Troubleshooting Practice	8A
▫ Troubleshoot a parallel circuit and identify if the circuit is operating properly.	
▫ Identify a faulted circuit as being open, shorted, or changed value.	
▫ Identify the component most likely to cause the fault.	
5021-116-400 Series-Parallel Circuits	9A
▪ Identify a series-parallel circuit.	
▪ Calculate total resistance in a series-parallel circuit.	
▪ Calculate current in a series-parallel circuit.	
▪ Calculate voltage drops in a series-parallel circuit.	
▫ Measure resistance values in a series-parallel circuit.	
▫ Measure current values in a series-parallel circuit.	
▫ Measure voltage drops in a series-parallel circuit.	

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MOD 3 - BASIC DC CIRCUITS (cont.)

- 5021-116-430 Series-Parallel Circuit Troubleshooting Theory ---
- Identify an open, short, and changed value component in a series-parallel circuit.
 - Analyze a series-parallel circuit and determine if the circuit is defective.
- 5021-116-460 Series-Parallel Circuit Troubleshooting Experiment 9A
- Determine if a series-parallel circuit is open and identify which component is open.
 - Determine if a series-parallel circuit has a short and identify which component is shorted.
 - Determine if a series-parallel circuit has a changed value and identify which component has a changed value.
- 5021-116-490 Series-Parallel Circuit Troubleshooting Practice 9A
- Troubleshoot a series-parallel circuit and identify if the circuit is operating properly.
 - Identify a faulted circuit as being open, shorted, or changed value.
 - Identify the component most likely to cause the fault.
- 5021-116-920 Basic DC Circuits Post-Test (Theory) ---
- 5021-116-960 Basic DC Circuits Post-Test (Performance) 9AW*
- Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
 - Demonstrate the ability to determine if a circuit is working properly using voltage, current, and resistance measurements.
 - Demonstrate the ability to troubleshoot a circuit using voltage, current, and resistance measurements.

MOD 4 - COMPLEX DC CIRCUITS

- 5021-118-130 Voltage Divider Circuits 9C
- Identify a voltage divider circuit.
 - Identify a voltage divider as being loaded or unloaded.
 - Calculate voltage, current, and resistance for loaded and unloaded voltage dividers.
 - Calculate % regulation for a voltage divider circuit.
 - Measure unloaded voltage divider voltages.
 - Measure loaded voltage divider voltages.
- 5021-118-160 Bridge Circuits 10A
- State the purpose of a bridge circuit.
 - Identify a bridge circuit.
 - Solve for voltage outputs.
 - Solve for unknown resistance.
 - Voltage measurements.
 - Resistance measurements.
- 5021-118-190 Introduction to Kirchhoff's Voltage and Current Laws 9C
- Identify a complex circuit.
 - State Kirchhoff's Current Law.
 - State Kirchhoff's Voltage Law.
 - Compare calculated and measured voltage in a circuit using Kirchhoff's Laws.
- 5021-118-220 Kirchhoff's Voltage and Current Laws 9C
- Identify a complex circuit.
 - State Kirchhoff's current law.
 - State Kirchhoff's voltage law.
 - Calculate current using Kirchhoff's laws.

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MOD 4 - COMPLEX DC CIRCUITS (cont.)

- 5021-118-220 Kirchhoff's Voltage and Current Laws (cont.)
 - Calculate voltage using Kirchhoff's laws.
 - Compare calculated and measured voltage in a circuit using Kirchhoff's Laws.
- 5021-118-250 Norton's Theorem ---
 - Describe the purpose of Norton's Theorem.
 - Describe the procedure in solving circuits using Norton's Theorem.
 - Nortonize a series-parallel circuit.
- 5021-118-280 Thevenin's Theorem ---
 - Describe the purpose of Thevenin's Theorem.
 - Describe the 6-step process in solving circuits using Thevenin's Theorem.
 - Thevenize a series-parallel circuit.
 - Thevenize a complex circuit.
- 5021-118-310 Multimeter Loading 9C
 - Describe the circuit loading effect of multimeters.
 - Describe how the multimeter loading is reduced.
 - Describe the Ohms per volt rating of analog multimeters.
 - Measure circuit voltages using an analog and digital multimeter.
 - Observe the loading effect of an analog multimeter.
- 5021-118-920 Complex DC Circuits Post-Test (Theory) ---
- 5021-118-960 Complex DC Circuits Post-Test (Performance) 9CW*
 - Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
 - Demonstrate the ability to determine if a voltage divider circuit is working properly using voltage and resistance measurements.

MOD 5 - WIRING

- 5021-214-130 PCB Component Insertion/Extraction Techniques ---
 - Identify the general characteristics of PC boards.
 - Identify several connection methods used on PC boards.
 - Identify the general techniques for inserting components into PC boards.
 - Identify common faults which may occur when installing components on PC boards.
 - Identify the general techniques for extracting components from PC boards.
 - Identify general techniques for repairing PC board traces and pads.
- 5021-214-160 Basic Soldering Techniques ---
 - Identify different types of solder and flux.
 - Select the correct soldering iron for a particular task.
 - Know how to properly prepare a wire for soldering.
 - Understand how to make a "Western Union" splice.
 - Identify different types of wire terminals and their connection methods.
 - Know how to make reliable solder connections.
 - Understand how to correct poor solder connections.
- 5021-214-190 Basic Connector Termination Techniques ---
 - Identify standard wire gauges.
 - Identify types of wire and cable.
 - Understand how cables and wires are typically used.
 - Understand basic connector termination techniques.

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MOD 5 - WIRING (cont.)

- 5021-214-190 Basic Connector Termination Techniques (cont.)
- Understand the correct method of terminating banana plugs, crimp connectors and BNC connections.
 - Know which skills are required to make routine repairs to electronic equipment.
- 5021-214-220 Basic Wire Wrapping Techniques ---
- Understand wire wrapping terminology.
 - Identify common types of wire wraps.
 - Identify common wire wrap tools.
 - Recognize the characteristics of good wire wrap.
 - Understand the procedure for making good wire wrap connections.
 - Recognize common wire wrapping faults.
- 5021-214-250 Basic Wiring and Connector Troubleshooting Theory ---
- Follow a logical troubleshooting procedure.
 - Describe open circuit measurements.
 - Describe short circuit measurements.
 - Describe changed value measurements.
 - Understand cable and connector labeling.
 - Describe how to make continuity checks of shielded and unshielded cables.
- 5021-214-280 Wire Troubleshooting w1, w2, w3
- Determine if a wire is open and identify which wire is open using continuity checks.
 - Determine if a wire is shorted and identify which wire is shorted using continuity checks.
 - Determine if a wiring circuit has a changed value and identify the component that has changed value using continuity checks.
 - Find an open and short using voltage and current measurements.
- 5021-214-920 Wiring Post-Test (Theory) ---
- 5021-214-960 Wiring Post-Test (Performance) w1w*, w2w*, w3w*
- Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
 - Demonstrate the ability to determine if a wiring harness is working properly using voltage and resistance measurements.

MOD 6 - INTRODUCTION TO AC CIRCUITS

- 5021-312-130 Alternating Current ---
- Define alternating current.
 - Identify an AC sine wave.
 - Define frequency and cycle.
 - Define the unit Hertz.
 - Determine the wavelength of a sine wave.
 - Determine the period of a sine wave.
- 5021-312-160 Generating AC Electricity ---
- Define the characteristics of induction.
 - Determine magnitude and polarity of voltage produced in a magnetic field.
 - Explain the operation of an AC generator.
 - Identify values of voltage and current at various electrical degrees.
 - Calculate peak, peak-to-peak, average, and RMS values.
 - Identify in and out of phase.

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MOD 6 - INTRODUCTION TO AC CIRCUITS (cont.)

- 5021-312-160 Generating AC Electricity (cont.)
 - Identify magnitude and degree of an AC wave using vectors.
- 5021-312-190 Non-Sinusoidal Waves ---
 - Identify harmonic frequencies.
 - Identify harmonic frequencies used to produce non-sinusoidal waves.
 - Define square waves.
 - Identify square wave cycles.
 - Define ramp waveforms.
 - Identify ramp waveforms.
- 5021-312-220 Resistance in AC Circuits ---
 - Use Ohm's Law to determine resistance in an AC series circuit.
 - Identify the relationship between voltage, current, and resistance in an AC series circuit.
 - Use Ohm's Law to determine resistance in an AC parallel circuit.
 - Identify the relationship between voltage, current, and resistance in an AC parallel circuit.
 - Use Ohm's Law to determine resistance in an AC series-parallel circuit.
 - Identify the relationship between voltage, current, and resistance in an AC series-parallel circuit.
- 5142-310-130 Magnetism and Electromagnetic Principles 182, 183
 - Define magnetism.
 - Describe different types of magnetism.
 - Describe relays, motors, transformers, and generators.
 - Observe magnetic poles.
 - Demonstrate temporary magnets.
 - Examine electromagnetic operation.
 - Demonstrate an application of magnetism.
- 5142-310-160 Magnetic Calculations ---
 - Describe properties of magnetic lines of force.
 - Identify magnetic and non-magnetic materials.
 - Identify the characteristics of electromagnetism.
 - Calculate magnetomotive force.
 - Calculate magnetic field strength.
 - Determine force.
 - Determine torque.
- 5021-312-920 Introduction to AC Post-Test (Theory) ---

MOD 7 - AC TEST EQUIPMENT

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

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MOD 7 - AC TEST EQUIPMENT (cont.)

5020-314-190 Oscilloscope Use with Function Generator	10
▫ Set up an oscilloscope for normal use.	
▫ Measure voltage using an oscilloscope.	
▫ Measure frequency using an oscilloscope.	
▫ Set up an oscilloscope for normal use.	
▫ Measure voltage using an oscilloscope.	
▫ Measure frequency using an oscilloscope.	
▫ Set up an oscilloscope for normal use.	
▫ Measure voltage using an oscilloscope.	
▫ Measure frequency using an oscilloscope.	
▫ Save and recall a waveform using the storage function of an oscilloscope.	
5020-314-430 Introduction to the Function Generator	---
▫ Describe the purpose of a function generator.	
▫ Identify the types of output signals generated by a function generator.	
▫ Identify the three major sections of a function generator.	
▫ Describe the purpose of each control and switch on a function generator.	
5020-314-460 Function Generator Use	10
▫ Set up a function generator for normal operation.	
▫ Adjust a function generator for various output signals.	
▫ Modulate an output signal.	
5020-314-730 Introduction to the Frequency Counter	---
▫ Describe the purpose of a frequency counter.	
▫ Describe the four major functions a frequency counter performs.	
▫ Determine the quantity measured from the display.	
▫ Identify the controls of a frequency counter and their purpose.	
5020-314-760 Frequency Counter Use	10
▫ Set up a frequency counter for normal operation.	
▫ Perform check, period, frequency, and totalize measurements.	
▫ Compare frequency and period measurements using a frequency counter and an oscilloscope.	
5020-314-920 AC Test Equipment Post-Test (Theory)	---
5020-314-960 AC Test Equipment Post-Test (Performance)	10w*
▫ Demonstrate the ability to properly set up a circuit and follow safety precautions.	
▫ Demonstrate the ability to use an oscilloscope to make voltage and frequency measurements.	

MOD 8 - INDUCTANCE AND RL CIRCUITS

5021-316-130 Introduction to Inductors	---
▫ Identify types of inductors.	
▫ Describe the current opposing characteristic of an inductor.	
▫ Identify the schematic symbol for an inductor.	
▫ Identify characteristics of inductance.	
▫ Identify the unit of measurement for inductance.	
5021-316-160 Inductor Identification	11
▫ Identify inductors.	
▫ Identify inductor color codes.	

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MOD 8 - INDUCTANCE AND RL CIRCUITS (cont.)

5021-316-190 RL Series Circuits	---
<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. 	

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MOD 9 - CAPACITANCE AND RC CIRCUITS (cont.)

5021-318-130 Introduction to Capacitors (cont.)	
▪ Describe charge and discharge characteristics of a capacitor.	
▪ Identify the schematic symbol for a capacitor.	
▪ Identify characteristics of capacitance.	
▪ Identify the unit of measurement for capacitance.	
5021-318-160 Capacitor Identification	11
▫ Identify ceramic, film, mica, and electrolytic capacitors.	
▫ Read the capacitance and voltage values.	
5021-318-190 RC Series Circuits	---
▪ Calculate total capacitance in series circuits.	
▪ Calculate total capacitive reactance in series circuits.	
▪ Calculate total impedance in series circuits.	
5021-318-220 RC Series Circuit Operation	12
▫ Measure the capacitive phase relationship between voltage and current.	
▫ Verify normal operation of an RC series circuit.	
5021-318-250 RC Series Circuit Troubleshooting Experiment	14A
▪ Identify an open component in an RC series circuit.	
▪ Identify a shorted component in an RC series circuit.	
▪ Identify a changed value component in an RC series circuit.	
▫ Observe an open component in an RC series circuit.	
5021-318-340 RC Parallel Circuits	---
▪ Calculate total capacitance in a parallel circuit.	
▪ Calculate total capacitive reactance in a parallel circuit.	
▪ Calculate total impedance in a parallel circuit.	
5021-318-370 RC Parallel Circuit Operation	12
▫ Measure the phase difference between the capacitive and resistive branches.	
▫ Verify normal circuit operation.	
▫ Measure the total current phase difference.	
5021-318-400 RC Parallel Circuit Troubleshooting Experiment	14A
▪ Identify an open component in an RC parallel circuit.	
▪ Identify a shorted component in an RC parallel circuit.	
▪ Identify a changed value component in an RC parallel circuit.	
▫ Observe an open component in an RC parallel circuit.	
▫ Observe a shorted component in an RC parallel circuit.	
5021-318-490 RC Filters	14A, 14B
▪ Identify RC filter circuits.	
▪ Describe RC filter circuit characteristics.	
▪ Calculate RC filter circuit values.	
▫ Measure RC low pass filter circuit values.	
▫ Compare measured RC low pass filter circuit values with calculated circuit values.	
▫ Measure RC high pass filter circuit values.	
▫ Compare measured RC high pass filter circuit values with calculated circuit values.	
5021-318-920 Capacitance and RC Circuits Post-Test (Theory)	---
5021-318-960 Capacitance and RC Circuits Post-Test (Performance)	14AW*
▫ Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.	

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MOD 9 - CAPACITANCE AND RC CIRCUITS (cont.)

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

MOD 10 - RC TIME CONSTANTS AND TRANSIENTS

- 5021-320-130 RC and RL Time Constants ---
- Describe RC time constants.
 - Calculate the amount of charge or discharge of a capacitor using RC time constants.
 - Describe RL time constants.
 - Calculate the amount of current present in an inductor using RL time constants.
- 5021-320-160 RC Time Constants Operation 15
- Observe capacitor charging and discharging using a multimeter.
 - Observe capacitor charging and discharging using an oscilloscope.
 - Verify RC time constants by the use of measurements.
- 5021-320-190 RC Circuit Transient Analysis ---
- Describe the effects a capacitor has on non-sinusoidal waveshapes.
 - Describe how long and short RC time constants affect waveshapes.
 - Describe how RC time constants relate to capacitive reactances.
- 5021-320-220 RC Circuit Transient Experiment 14A
- Predict effects on voltage and current as frequency changes.
 - Measure voltage waveform across a capacitor with a square wave applied.
 - Measure current waveform across a capacitor using a sampling resistor.
- 5021-320-250 RC Circuit Transient Troubleshooting Experiment 14A
- Describe typical faults in an RC transient circuit.
 - Describe RC circuit transient troubleshooting procedures.
 - Describe the effects of open, shorted, and changed value components.
 - Recognize that an RC transient circuit is faulted.
 - Observe the effects of an open and shorted component in an RC transient circuit.
- 5021-320-920 RC Time Constants and Transients Post-Test (Theory) ---
- 5021-320-960 RC Time Constants and Transients Post-Test (Performance) 14BW*, 804W*
- Demonstrate the ability to properly set up a circuit, correctly use test equipment, and follow safety precautions.
 - Demonstrate the ability to make charge time and period measurements in an RC circuit using an oscilloscope.
 - Demonstrate the ability to determine if an RC circuit is working properly using charge time and period measurements.
 - Demonstrate the ability to troubleshoot an RC circuit using voltage and frequency measurements.

MOD 11 - RESONANCE

- 5021-322-130 Capacitive/Inductive Reactance and LCR Circuits ---
- Describe the effects of inductors and capacitors when used in the same circuit.
 - Calculate circuit values in a series LCR circuit.
 - Calculate circuit values in a parallel LCR circuit.
- 5021-322-160 Series and Parallel LCR Circuit Experiment 17, 19
- Calculate and measure the voltage drops in a series LCR circuit.

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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 V, 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.

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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. 	

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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.

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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.

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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

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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>5021-518-160 Full- and Half-Wave Rectifier Operation 23</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. 	23
<p>5021-518-190 Bridge Rectifier Operation 24</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. 	24
<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>5021-518-250 Zener Diode Operation 22B</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. 	22B
<p>5021-518-280 Zener Diode Regulator Operation 23, 25</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. 	23, 25
<p>5021-518-310 Voltage Regulator Operation 23, 26</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. 	23, 26
<p>5021-518-340 Voltage Regulator Troubleshooting Experiment 23, 25, 26</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. 	23, 25, 26

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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)	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.	

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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.

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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.	

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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, 45, 46
 - 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.

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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. 47N
- 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.

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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.

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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. 	

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MOD 23 - SWITCHING POWER DEVICES (cont.)

5021-612-190 Metal-Oxide Semiconductor Field Effect Transistor (MOSFET)	551
▪ Recognize power MOSFET schematic symbols.	
▪ Describe the construction of power MOSFET devices.	
▪ Describe the power MOSFET as a switching device.	
▫ Test and confirm normal operation of a switching MOSFET.	
▫ Perform measurements on a metal-oxide field effect transistor.	
▫ Confirm the normal operation of a switching MOSFET circuit.	
▫ Troubleshoot switching MOSFET circuitry.	
5021-612-220 Insulated-Gate Bipolar Transistor (IGBT)	551
▪ Recognize IGBT schematic symbols.	
▪ Describe the construction of IGBT devices.	
▪ Describe the IGBT as a switching device.	
▫ Test and confirm normal operation of a switching IGBT.	
▫ Perform measurements on the switching IGBT circuitry.	
▫ Confirm the normal operation of a switching IGBT circuit.	
▫ Troubleshoot switching IGBT circuitry.	
5021-612-920 Switch Power Devices Post-Test (Theory)	---

MOD 24 - INTRODUCTION TO DIGITAL CIRCUITS

5022-712-130 Introduction to Digital Electronics	2404
▪ Identify developments of digital electronics.	
▪ Describe the growth of computing equipment.	
▪ Identify uses of digital electronics.	
▪ Describe input and output conditions for digital circuits.	
▪ Identify the AND, OR, and NOT functions.	
▪ Recognize the digital truth table.	
▪ Recognize the AND, OR, and NOT Boolean equations.	
▫ Observe the operation of various digital gates.	
▫ Read a truth table.	
▫ Recognize HIGH and LOW outputs.	
5022-712-160 Digital Electronics Hardware	---
▪ Define integrated circuit.	
▪ Identify three forms of integrated circuit packaging.	
▪ Identify markings associated with integrated circuits.	
▪ Identify integrated circuit functions.	
▪ Describe the purpose of a data book.	
5022-712-190 Digital Test Equipment	2402
▪ Describe the purpose of a clock generator circuit.	
▪ Identify the signals produced by the clock generator.	
▪ Identify the basic components of a clock generator.	
▪ Describe the purpose of a logic probe.	
▪ Describe basic operation of a logic probe.	
▫ Operate a simple clock generator circuit.	
▫ Operate a logic probe.	
5022-712-210 555 Timer	153
▪ Describe the purpose of the 555 timer.	

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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.

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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.

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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.

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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.	

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MOD 29 - ARITHMETIC COUNTING CIRCUITS (cont.)

5022-722-130 Introduction to Arithmetic Counting Circuits (cont.)	2414
▪ 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.	

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<u>MOD 30 - CONVERSION AND DATA CIRCUITS (cont.)</u>	
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)	---

Notes:

* Cards must be purchased separately.

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www.TECedu.com | 800-338-2238

Nida Corporation
Melbourne, Florida 32904
300 S. John Rodes Blvd
Tel: 321-727-2265 • Fax: 321-727-2655
www.nida.com