



**NIDA CORPORATION
COMPUTER ASSISTED INSTRUCTION**

LESSON AND OBJECTIVE LISTING

**Master Course Listing
Mechatronics**

2018-08-30

OBJECTIVE LISTING - Master Course Listing

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CARDS/KITS

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.	
▪ 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.	

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MOD 39 - TRANSDUCER SYSTEMS (cont.)

5142-114-130 Nature of Motion (cont.)	
▪ 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.	
5142-312-160 DC Motors and Generators	180
▪ 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
▪ 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.	

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MOD 40 - INTRODUCTION TO MOTORS (cont.)

- 5142-312-220 AC Motors and Generators ---
- 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 ---
- 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 ---
- 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 ---
- 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
- 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.
- 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.

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MOD 41 - MOTOR CONTROL SYSTEMS (cont.)

- 5142-318-130 Motion Detection (cont.)
 - 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.

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.

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MOD 42 - SYNCHRO SERVO SYSTEMS (cont.)

- 5142-512-190 Control Synchro Systems (cont.)
 - 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.
- 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.

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MOD 43 - HYDRAULIC AND PNEUMATIC SYSTEMS (cont.)

- 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.
 - 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.

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MOD 44 - PROGRAMMABLE LOGIC CONTROLLERS (cont.)

- 5142-612-250 PLC Troubleshooting (cont.)
 - 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.
 - 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.

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<u>MOD 44 - PROGRAMMABLE LOGIC CONTROLLERS (cont.)</u>	
5142-614-400 Bit Shift, FIFO, and LIFO Instructions	1
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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	---
<ul style="list-style-type: none"> ▫ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ 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
<ul style="list-style-type: none"> ▪ Understand the concepts of move instructions. ▪ Describe the operation of move instructions. 	

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MOD 44 - PROGRAMMABLE LOGIC CONTROLLERS (cont.)

5142-614-340 Move and Logical Instructions (cont.)	
▪ 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.	

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