# NIDA CORPORATION
# COMPUTER ASSISTED INSTRUCTION


# LESSON AND OBJECTIVE LISTING


# Master Course Listing
# Mechatronics


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Representative



**Technology Education Concepts**
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LESSON ID/TITLE                                                                                          CARDS/KITS

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- ▪ Understand transducer operating principles.

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

5142-112-190  Light Transducers . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .  ---
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5142-112-250  Nature of Heat . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .  ---
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- ▪ Describe the classification of thermo-electronic devices.
- ▪ Describe heat.
- ▪ Describe heat measuring systems.
- ▪ Describe heat units.

5142-112-280  Heat Transducers . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .  ---
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- ▪ Describe thermal resistance.
- ▪ Describe heat dissipation.
- ▪ Describe mechanical heat sensors.
- ▪ Describe thermocouples.
- ▪ Describe thermistors.
- ▪ Describe resistance temperature detectors.
- ▪ Describe solid state sensors.

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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.

LESSON ID/TITLECARDS/KITS

## 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
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5142-114-220  Nature of Position . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ---
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- Calculate various output quantities of prime movers.

5142-114-250  Position Transducers . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ---
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## MOD 40 - INTRODUCTION TO MOTORS

5142-312-130  Introduction to Rotating Machinery . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ---
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- Describe Speed, Torque, Counter Electromotive Force (CEMF), Loads, Power, and Efficiency in rotating machinery.

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## MOD 40 - INTRODUCTION TO MOTORS (cont.)

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- ▪ 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 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .  ---
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- ▪ 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
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- ▪ Describe the operation of a PWM amplifier/driver.
- ▫ Measure signals at various points throughout a PWM circuit.
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- ▫ Measure circuit frequency and calculate rpm.
- ▫ Measure armature voltages.
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- ▫ Compute linear and rotary motion rates based on system mechanical and electrical parameters.

**MOD 41 - MOTOR CONTROL SYSTEMS (cont.)**

5142-318-130  Motion Detection (cont.)
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5142-318-160  Error Detection and Feedback  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 177, 178, 179
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- ▪ List the functions that a closed loop feedback system performs.
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5142-318-190  Troubleshooting Closed Loop Systems . . . . . . . . . . . . . . . . . . . . . . . 177, 178, 179
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- ▪ 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  . . . . . . . . . . . . . . . . . . . . . . . ---
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- ▪ Identify the principles of proportional and integral control.
- ▪ Identify the principles of proportional, integral, and derivative control.

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**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.

## MOD 42 - SYNCHRO SERVO SYSTEMS (cont.)

5142-512-190  Control Synchro Systems (cont.)
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- 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.
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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
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- Identify areas of a PLC controlled system most likely to fail.
- Identify areas of a PLC controlled system least likely to fail.

**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.

**MOD 44 - PROGRAMMABLE LOGIC CONTROLLERS (cont.)**

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

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

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

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

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

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

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- ▪ 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.

## 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.

**NOTES**

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