

Automation and Robotics | One-Year Program: Scope & Sequence

Year 1, Semester 1

AR101 - Automation and Robotics I (90 days)

(90 days) (42 Days Class, 48 Days Lab, 53% Lab)

District Pre-Assessment

Unit 1 (10 Days – 5 Class, 5 Lab)

Basic Safety: Demonstrate knowledge of safety, health, and environmental rules and regulations to avoid workplace injury and maximize machine productivity.

- Demonstrate knowledge of electrical safety standards and procedures to maintain industrial equipment safely.
- Demonstrate knowledge of safety practices of mechanical and fluid-controlled systems to maintain industrial equipment safely.
- Demonstrate knowledge of proper fall protection.
- Select appropriate Personal Protective Equipment (PPE) for various industrial safety situations.
- Describe how to appropriately use Personal Protective Equipment (PPE) for industrial safety situations.

CTSO Integration (Leadership Skills): SkillsUSA Officer Elections and Training

Professional Skills: 1.A-D, 4.A-F, 7.A-C

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, 5.NF.B.3, 5.NF.B.6, 5.NF.B.7

Work-based Learning: Industry Guest Speaker

Technical Standards: 2.1-2.6

Unit 2 (10 Days – 7 Class, 3 Lab)

Fundamentals of Industry 4.0

- Explain what Industry 4.0 is.
- Discuss how these changes impact the industry, current and future employees, and other members of the manufacturing value chain.
- Give examples of the benefits and value of Industry 4.0.
- Explain the 'interconnected world'.
- Define important terms, theories, and ideas behind Industry 4.0.

CTSO Integration (Leadership Skills): SkillsUSA Officer Elections and Training

Professional Skills: 1.A-D, 4.A-F, 7.A-C

Academic Standards: ELA.11-12.SL.4, ELA.11-12.L.4, 5.NF.B.3, 5.NF.B.6, 5.NF.B.7

Work-based Learning: Journal Writing (Notebooks)

Technical Standards: 1.1-1.5

Certifications: NC3 Fundamentals of Industry 4.0

Unit 3 (30 Days - 10 Class, 20 Lab)

Fundamentals of Industrial Robotics

- Robotic safety review
- Basics of robotic systems, including design, operation, and applications.
- Overview of robotic technologies impacting business and manufacturing.
- Identify and explain the design and function of various types of robotic systems.
- Safely operate and maintain robotic systems.
- Program various robotic systems.
- Commission and teach robotic programs and positions.
- Understand and define control instructions.
- Troubleshoot and diagnose robotic systems.
- Optimize robot paths and movement.
- Understand network and communication protocols.

CTSO Integration (Leadership Skills): SkillsUSA Meeting

Professional Skills: 1.A-D, 4.A-F, 7.A-C

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 5.NF.B.3, 5.NF.B.6, 5.NF.B.7

Work-based Learning: Mock Interview

Technical Standards: 12.1-12.6, 15.1-15.9, 16.1-16.6

Certifications - Universal Robots EDU Certification, NC3 Festo Fundamentals of Robotics

Unit 4 (20 Days - 10 Class, 10 Lab)

Introduction to Mechanical Systems and Components

- Proper safety protocols are associated with performing work on mechanical systems.
- Explain gear reduction and install a belt or chain drive
- Explain the gear ratio and install a gear train
- Basics of robotics-related mechanical systems, including belts, gears, and chains
- Compute the advantage belt, chain drive, and gear train.
- Understanding of belt drives and their roles in industrial applications.
- Proper installation of belt drives and the importance of following specific protocols.
- Identification of the main components of the belt drive systems in industrial installations.

- Understanding of chain drives and their roles in industrial applications.
- Proper installation of chain drives and the importance of following specific protocols. Identification of the main components of chain drive systems in industrial installations.
- Understanding of gear drives and their roles in industrial applications.
- Proper installation of gear drives and the importance of following specific protocols.
- Identification of the main components of gear drive systems in industrial installations.

CTSO Integration (Leadership Skills): Fall Conference

Professional Skills: 1.A-D, 4.A-F, 7.A-C

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 5.NF.B.3, 5.NF.B.6, 5.NF.B.7

Work-based Learning: Resume Writing

Technical Standards: 9.1-9.8; 10.1-10.7

Certification: NC3 Fundamentals of Mechanical Systems

Unit 5 (20 Days - 10 Class, 10 Lab)

Basics of Electrical Systems

- Explain the working principles of an electrical circuit.
- Apply Ohm's Law and Kirchhoff's Law, using digital multimeters, interpreting series/parallel circuits, and assessing power/circuit protection.
- Safely and effectively measure an electrical circuit.
- Identify, sketch, and describe basic electrical components and devices.
- Build, test & troubleshoot basic electrical circuits.
- Read electrical drawings (i.e., simple starter circuits, PLC output, etc.)
- Calculate impedance and inductive/capacitive reactance.
- Measure and determine voltage, current, resistance, and power in AC and DC circuits (i.e., oscilloscope, volt/ohm, meter, etc.)
- Troubleshooting various complex AC circuits with faults using a voltmeter and an ohmmeter.
- Troubleshooting various complex DC circuits with faults using a voltmeter and an ohmmeter.

CTSO Integration (Leadership Skills): Rnd 1 Mock Interview

Rnd 1 Professional Skills: 1.A-D, 4.A-F, 7.A-C

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 5.NF.B.3, 5.NF.B.6, 5.NF.B.7

Work-based Learning: Mock Interviews

Technical Standards: 4.1-4.11, 6.1-6.8

Certifications: NC3 Fundamentals of Electricity DC

Semester Exam

Year 1, Semester 2

AR102 - Automation and Robotics II

(90 days) (43 Days Class, 47 Days Lab, 52% lab)

Unit 6 (10 Days - 5 Class, 5 Lab)

Drafting in Manufacturing

- Basics of drafting and schematics
- Creating CAD representations for sketches
- Create dimensional CAD drawings (2D and 3D)
- Interpret Electrical Drawings and architectural plans

CTSO Integration (Leadership Skills): Guest Speaker

Professional Skills: 1.A-D, 4.A-F, 7.A-C

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 5.NF.B.3, 5.NF.B.6, 5.NF.B.7

Work-based Learning: Presentation Skills

Technical Standards: 3.1-3.9, 11.1-11.6

Unit 7 (10 Days - 5 Class, 5 Lab)

Fundamentals of Sensors

- Understand and explain the fundamentals of sensor technology.
- Recognize sensor functionality and select the appropriate sensor for various industrial applications
- Interpret the language, symbology, and protocols commonly used in the sensor field
- Explain how the various types of sensors work and function – Make electrical connections and test the sensor for proper operation
- Troubleshoot, repair/replace a faulty sensor
- Configuration and function of the sensors used
- Basic principles of connection and circuit technology – Configuration of logic circuits
- Selection of appropriate sensors by considering specific parameters
- Signal processing and filtering
- Calibration and maintenance of sensors

CTSO Integration (Leadership Skills): SkillsUSA Meeting

Professional Skills: 1.A-D, 4.A-F, 7.A-C

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 5.NF.B.3, 5.NF.B.6, 5.NF.B.7

Work-based Learning: Manufacturing Field Trip

Technical Standards: 14.1-14.7

Certifications - NC3 Festo PLC Sensors 1

Unit 8 (14 Days - 5 Class, 9 Lab)

Introduction to Mechatronics

- Identify the components of automated systems.
- Explain and demonstrate the functionality of Pneumatics, Electrical, and Mechanical components.
- Utilize software tools to design, simulate, and control automated systems.
- Identify the elements of Programmable Logic Controllers.
- Analyze logic circuits and develop sequence programs.
- Apply the engineering design process to create automated systems and solutions.
- Apply critical thinking, problem-solving, and teamwork.
- Explain the function of electro-pneumatic systems.
- Explain and demonstrate the function of Stacking, Conveying, and Handling Systems.

CTSO Integration (Leadership Skills): SkillsUSA Framework

Professional Skills: 1.A-D, 4.A-F, 7.A-C

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5, ELA.11-12.SL.4, ELA.11-12.L.4, 5.NF.B.3, 5.NF.B.6, 5.NF.B.7

Work-based Learning: Career-related Research

Technical Standards: 15.1, 15.3, 15.8, 15.9

Certification: NC3 Introduction to Mechatronics

Unit 9 (20 Days -10 Class, 10 Lab)

Fundamentals of PLC's

- Explain the operation and design of various relays
- State/explain the three PLC sections
- State/explain the three types of input devices
- State/explain the types of memory in a PLC
- Explain the different types of PLC addressing
- State/explain the three types of output devices
- Convert different numbering systems used in a PLC
- Explain various Boolean gates/truth tables
- Demonstrate how to use a PLC for troubleshooting to resolve problems quickly
- Understand and apply communication protocols
- Integrate and configure HMIs

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Fundraiser

Professional Skills: 2.A-C, 4.A-F

Academic Standards: ELA.11-12.W.4, ELA.11-12.SL.4

Work-based Learning: Resume, Mock Interview

Technical Standards: 8.1-8.6, 14.1-14.7

Certifications: NC3 Level 1 Fundamentals of PLCs

Unit 10 (8 Days – 4 Class, 4 Lab)

Fundamentals of Pneumatic Systems

- Demonstrate safety standards and best practices, adhering to safety protocols in pneumatic systems
- Interpret and draw pneumatic symbols
- Identify components of a pneumatic system.
- Utilize circuit simulation software to design, test, and optimize circuits.
- Understand the principles and applications of vacuum systems.
- Construct and troubleshoot pneumatic circuits.
- Understand the practical application of Pascal's and Boyle's law.
- Explain and understand the conditioning and distribution of air.
- Determine the root cause of component failure.
- Make speed adjustments to actuators.
- Explain the force/pressure/area relationship.
- Describe the different states an actuator can assume and the importance of each.
- Utilize simulation software to demonstrate basic diagnostic principles.
- Identify/explain the function of pneumatic components.

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Prepare for Regional Competition

Professional Skills: 3.A-E, 4.A-F

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5,

ELA.11-12.SL.4, ELA.11-12.L.4, 7.RP.A.3, 6.EE.A.2

Work-based Learning: SkillsUSA Regional Competition

Technical Standards: 7.1-7.10

Certifications: NC3 Fundamentals of Fluid Power - Pneumatic

Unit 12 (8 Days – 4 Class, 4 Lab)

Fundamentals of Hydraulic Systems

- Design, assemble, test, and troubleshoot basic hydraulic circuits. Identify and describe the construction, design features, and operation of hydraulic components.
- Interpret technical specifications and data relating to hydraulic components and systems.
- Identify and explain graphical symbols for hydraulic components.
- Describe the fundamentals of oil flow.

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Regional Competition

Professional Skills: 3.A-E, 4.A-F

Academic Standards: ELA.11-12.W.4, ELA.11-12.W.5,

ELA.11-12.SL.4, ELA.11-12.L.4, 7.RP.A.3, 6.EE.A.2

Work-based Learning: Mock Interview, Guest Speaker

Technical Standards: 7.1-7.10

Certifications: NC3 Fundamentals of Fluid Power - Hydraulic

Unit 4 (20 Days – 10 Class, 10 Lab)

Applied Robotic Systems:

- Describe robotics operating systems
- Identify the problem and develop a flowchart for software development
- Identify the peripheral hardware required to complete the task
- Develop or reuse software components
- Use software tools to create robotic applications
- Use a simulation to develop and validate a design for a robotic problem
- Use a test drive development approach
- Demonstrate a methodical approach to process development
- Describe integration technologies
- Describe robotics project constraints
- Select data communication protocols and associated connectors
- Identify tradeoffs among wired and wireless data communication protocols
- Explain IoT and IIoT

CTSO Integration (Leadership Skills): SkillsUSA Chapter Meetings, Fundraiser, Fall Leadership Conference

Professional Skills: 2.A-C, 4.A-F

Academic Standards: ELA.11-12.W.4, ELA.11-12.SL.4,

ELA.11-12.L.4

Work-based Learning: Industry Field Trip

Technical Standards: 12.1-12.6, 15.1-15.9

Certification: NC3 Applied Robotics, FANUC Robot, and KUKA Robot

District Post-Assessment

Certification: SACA Certified Industry Level 1