Robotics and Automation

Curriculum Guide

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Contents

CTECS – Vision of a Graduate

The Vision of a Graduate (VoG) at the Connecticut Technical Education and Career System (CTECS) embodies our commitment to preparing students for success in Connecticut's workforce.

Developed in collaboration with students, parents, staff, and employers, the VoG ensures that CTECS students are not only job-ready but also equipped to lead, innovate, and adapt in a dynamic world.

As educators, we are dedicated to developing these qualities by providing a comprehensive education that empowers our students to achieve their fullest potential and make meaningful contributions to society.

A Problem Solver

Problem solvers tackle challenges by identifying root causes of issues, brainstorming solutions, implementing effective strategies, and demonstrating adaptability.

- Engage students with open-ended, creative thinking tasks that require both conventional and innovative solutions.
- Facilitate group discussions and collaborative projects.
- Use real-world scenarios and hands-on activities.
- Highlight the importance of effort, persistence, and continuous learning.
- Provide regular feedback and encourage reflection.

Work Ready

To be work-ready includes a combination of technical expertise, soft skills, and personal qualities that ensure a graduate can effectively contribute to the workplace from day one.

- Set high standards for punctuality, responsibility, professionalism, and task completion.
- Use project-based learning and collaborative assignments.
- Emphasize clear written and verbal communication.
- Offer practical exercises like mock interviews and resume workshops.
- Integrate technology and teach digital literacy.

Respectful

Graduates who embody respectfulness emphasize the importance of treating others with dignity, valuing diversity, and fostering an inclusive and positive environment, both personally and professionally.

- Demonstrate personal, interpersonal, and professional skills.
- Show respect for diversity.
- Model respect through active listening and empathy.
- Set clear expectations for respectful interactions.
- Promote collaboration and group discussions.
- Celebrate respectful behavior.
- Address disrespect promptly and constructively.

Skilled Socially

Graduates who are skilled socially are equipped to navigate social environments, build relationships, and contribute positively to their communities and workplaces.

- Show awareness of global responsibility to others and the environment.
- Participate in community involvement.
- Design cooperative group projects and team activities
- Set expectations for respect and give regular feedback.
- Facilitate discussions on inclusivity, kindness, and respect.
- Model positive interactions and recognize strong social skills.

A Critical Thinker

Critical thinkers approach problems systematically by analyzing, evaluating, and synthesizing information to make well-informed decisions and contribute to innovative solutions.

- Encourage critical thinking individually and collaboratively.
- Design lessons that challenge assumptions and explore diverse viewpoints.
- Use open-ended questions, rigorous activities, and cross-curricular projects.
- Integrate project-based learning and real-world problem-solving.
- Offer reflective opportunities like journaling and discussions.
- Cultivate an environment that values curiosity and inquiry.

An Effective Communicator

Effective communicators convey ideas, information, and emotions accurately and persuasively, fostering understanding and collaboration.

- Communicate effectively using oral, written, visual, artistic, and technical modes.
- Include group discussions, presentations, and peer reviews.
- Promote active listening and thoughtful responses.
- Offer clear guidelines and constructive feedback.
- Stress clear, respectful, and purposeful communication.

CTECS Instructional Model

CTECS uses the Marzano Compendium to guide research-based instructional strategies that differentiate learning and promote access, engagement, and success for all students. Teachers apply these strategies to support diverse learners (including multilingual learners, students with disabilities, and students with varied academic or technical backgrounds) through scaffolds, modeling, guided practice, and multiple ways to participate and show understanding. This approach ensures every student can work toward proficiency in the Priority Standards and the competencies outlined in the CTECS Vision of a Graduate.

Feedback	Content	Context
Providing and Communicating Clear Learning Goals 1. Providing scales and rubrics 2. Tracking student progress 3. Celebrating success **Using Assessments** 4. Using informal assessments of the whole class 5. Using formal assessments of individual students	**Conducting Direct Instruction Lessons** 6. Chunking content 7. Processing content 8. Recording and representing content **Conducting Practicing and Deepening Lessons** 9. Using structured practice sessions 10. Examining similarities and differences 11. Examining errors in reasoning **Conducting Knowledge Application Lessons** 12. Engaging students in cognitively complex tasks 13. Providing resources and guidance 14. Generating and defending claims **Using Strategies That Appear in All Types of Lessons** 15. Previewing strategies 16. Highlighting critical information 17. Reviewing content 18. Revising knowledge 19. Reflecting on learning 20. Assigning purposeful homework 21. Elaborating on information 22. Organizing students to interact	**Using Engagement Strategies** 23. Noticing and reacting when students are not engaged 24. Increasing response rates 25. Using physical movement 26. Maintaining a lively pace 27. Demonstrating intensity and enthusiasm 28. Presenting unusual information 29. Using friendly controversy 30. Using academic games 31. Providing opportunities for students to talk about themselves 32. Motivating and inspiring students **Implementing Rules and Procedures** 33. Establishing rules and procedures 34. Organizing the physical layout of the classroom 35. Demonstrating withitness 36. Acknowledging adherence to rules and procedures 37. Acknowledging lack of adherence to rules and procedures **Building Relationships** 38. Using verbal and nonverbal behaviors that indicate affection for students 39. Understanding students' backgrounds and interests 40. Displaying objectivity and control **Communicating High Expectations** 41. Demonstrating value and respect for reluctant learners 42. Asking in-depth questions of reluctant learners 43. Probing incorrect answers with reluctant learners

Curriculum Introduction

This curriculum document outlines the essential learning for this trade program and provides a clear structure for planning, instruction, and assessment. It includes the components required by NEASC Standard 2.2a, along with elements that reflect the unique nature of CTECS technical programs. The curriculum is organized to show what students learn in each course, how learning progresses across grade levels, and how instruction supports both technical skill development and the CTECS Vision of a Graduate.

Teachers should use this document to:

- Understand the overall structure and expectations of the course sequence
- Reference the Course Map to see the scope and sequence of Priority Standards and the alignment to District Summative Assessments (DSAs)
- Use the Priority Standards and Units of Study to guide daily, weekly, and cycle-based planning
- Integrate Big Ideas, Essential Questions, Skills/Learning Outcomes, vocabulary, and resources during lesson design
- Identify required safety, industry, and technical content expectations
- Plan and implement formative assessments to monitor progress and guide instruction
- Prepare students for the District Summative Assessments, ensuring alignment with the Course Map
- Maintain consistency of technical and professional practice instruction across campuses while adapting to student needs and industry-based opportunities

Curriculum Components

Course Map

A Course Map serves as the scope and sequence for this course by outlining the progression of instructional units and the standards that guide teaching and assessment. While each campus will have individual student needs, cycle schedules, and industry-based opportunities, all instructors are expected to teach the standards outlined in the Course Map. Using the Course Map below, teachers will intentionally plan learning experiences that prepare students to meet the identified standards within the designated assessment windows.

Priority Standards (Units of Study)

Priority Standards identify the most essential learning in the trade program. They reflect the core technical competencies, safety practices, and industry-aligned skills that require the greatest instructional focus and appear on program assessments. In CTE programs, each Priority Standard also functions as a Unit of Study, because it includes the required components such as big ideas, essential questions, content topics, and skills/learning outcomes aligned to assessments.

Vertical Alignment

Vertical alignment shows how Priority Standards and instructional expectations progress from grade to grade within the trade program. It provides a clear pathway of skill development, increasing complexity, and technical proficiency across the four-year sequence.

Learning Outcomes

Learning outcomes are what students will know (Concepts) and be able to do (Skills). Concepts identify the major content topics within the Priority Standard (Unit of Study). They appear in the left column of the Learning Outcomes table and follow a similar coding structure as the Priority Standard.

Skills are learning objectives that describe the measurable actions students must be able to perform to demonstrate proficiency. They appear in the right column of the Learning Outcomes table and show the progression of learning evidence in the Priority Standard.

Vocabulary

Essential vocabulary includes the technical and academic terms students must understand and use accurately to engage in trade-specific learning and demonstrate proficiency on assessments. Vocabulary is foundational to safety, technical precision, and industry communication, and should be a primary initial focus within each unit and taught explicitly through modeling, demonstration, and repeated application.

Resources

Resources include the tools, equipment, texts, materials, and digital tools that support learning within each unit and reflect industry standards.

Assessment Practices

Teachers use ongoing formative assessments—such as questioning, checks for understanding, performance demonstrations, reflections, and teacher observation—to monitor progress, guide instruction, and support all learners in mastering the Priority Standards.

Each program also includes District Summative Assessments (DSAs), which measure proficiency on the Priority Standards identified in the Course Map. DSAs provide consistent evidence of student learning across campuses and ensure alignment to industry expectations, safety requirements, and program outcomes. Teachers should reference the Course Map and Units of Study when planning instruction to ensure students have opportunities to practice and demonstrate the skills and knowledge assessed on the DSA.

Robotics and Automation Program Philosophy

The **Robotics and Automation** program provides foundational theory and applied technical content aligned to industry expectations. Students gain practical experience through hands-on learning with robotic systems, automated equipment, sensors, and controls in the school lab, participation in system integration and programming projects, and optional Work-Based Learning placements with manufacturing, automation, or technology-focused industry partners. These experiences allow students to apply automation principles and robotic programming in authentic settings and prepare them for continued growth within advanced manufacturing and Industry 4.0 career pathways.

Robotics and Automation – Course Map (one year)

Semester 1 – Quarter 1 & 2 DSA

- 1.1 Shop Safety OSHA-10
- 1.2 Career Readiness
- 1.3 Electricity

- 2.1 Mechanical Systems
- 2.2 Industrial wiring practice
- 2.3 AC / DC Motors
- 2.4 Total Preventative Maintenance

Semester 2 – Quarter 3 & 4 DSA

- 3.1 Motor Control
- 3.2 Fluid Power Pneumatics
- 3.3 Fluid Power Hydraulics
- 3.5 Total Preventative Maintenance

- 4.1 Digital Logic
- 4.2 Automated Control Systems
- 4.3 Sensor Technology
- 4.4 Robotics
- 4.5 Total Preventative Maintenance

Priority Standard Q1.1 – Shop safety.	
Big Idea(s): • **Safety is the responsibility of everyone in the shop.** • **Training and awareness can prevent injuries.**	
Essential Question(s): • **How can hazard awareness prevent accidents?** • **Can training and awareness prevent injuries?** • **Who is ultimately responsible for workers' safety?**	
Learning Outcomes	
Students will know:	**As evidenced by:** **(Oral, written, or performance):**
Q1.1.1 Safe work habits.	• Identify Personal Protective Equipment • Demonstrate appropriate P.P.E. use • Explain the importance of SDS in the shop • Follow shop safety rules • Maintain a clean work area/shop • Locate Emergency shut offs in shop • 100% on written safety test
Q1.1.2 Fire Safety	• Identify classes of fires • Locate fire extinguishers and blankets in shop • Identify types of extinguishers • Explain the process of extinguishing certain fires • 100% on written safety test
Q1.1.3 First Aid	• Describe procedures for dealing with various injuries. • Explain the dangers blood borne pathogens • 100% on written safety test
Q1.1.4 OSHA	• Completion of OSHA – 10-hour – General Industry. • Receipt of OSHA – 10 certifications.
Q1.1.5 Ladder Safety • Step Ladder Safety • Articulated Ladder Safety • Single and Extension Ladder Safety	• Explain and demonstrate how ladders are to be used safely. • Identify components and procedures of using ladders.

• Mobile Ladder Safety.	• Obtaining 100% on written safety test.
Technical Vocabulary: Personal Protective Equipment (P.P.E.), Dress Code, Safety Data Sheet (SDS), Fire Extinguisher. Fire Triangle, Blood borne Pathogens, Automatic Electrical Defibrillator (AED), Eye Wash Station, Emergency Shut-off, Ground-fault Circuit Interrupter (GFCI), Hazardous Material Identification System (HMIS), Occupational Safety and Health Administration (OSHA), Threshold Limit Value (TLV), Lockout / Tagout (LOTO), Pinch Point, Environmental Protection Agency (EPA)	
Resources – Industrial Maintenance and Mechatronics 2nd Edition Career Safe – On-line OSHA-10 Training	

Priority Standard Q1.2 - Career Readiness

Big Idea(s):

- **Success skills are just as important, if not more, than technical skills.**
- **Careers in Mechatronics Robotics and Automation Engineering Technology are varying, vast, and there is something for everyone.**

Essential Question(s):

- **What are the essential personal and professional skills needed to be successful in Mechatronics Robotics and Automation Engineering Technology?**
- **How can soft skills help to increase the likelihood of success?**

Learning Outcomes

Students will know:	**As evidenced by: (Oral, written, or performance):**
Q1.2.1 Job Opportunities	• Research job opportunities in Mechatronics Robotics and Automation Engineering Technology • List job requirements for entry-level employment in Mechatronics Robotic and Automation Engineering Technology

Q1.2.2 Employability Skills	• Demonstrate good attendance
	• Adhering to shop rules
	• Demonstrate Professionalism
	  ○ Dress code
	  ○ Readiness
	  ○ Hygiene

Technical Vocab- Attitude, Body Language, Conflict Management, Ethical Behavior, Mechatronics, National Institute for Metalworking Skills (NIMS), Nonverbal Communication, Punctual, Reference, Resume, Self-motivation, Team, Verbal Communication.

Resources- Industrial Maintenance and Mechatronics 2nd Edition
Shop Rules
Student Handbook
Teacher Modeling Industry standards

Priority Standard Q1.3 - Electricity

Big Idea(s):

- **The resistor's physical size has nothing to do with its resistance value.**
- **All electronic circuitry is based on the relationships between current, voltage, resistance, and power OHMs Law.**
- **Test equipment is essential to troubleshooting, and repairing circuitry.**

Essential Question(s):

- **Why are some resistors physically larger than others?**
- Why is solving for unknown values in a circuit important for a technician?
- Why is it important to understand the use to industry standard test equipment?

Learner Outcomes

Students will know:	**As evidenced by (Oral, written, or performance):**
Q1.3.1 Engineering Notation - Metric prefix	• Converting from Engineering Notation to Decimal • Converting from Decimal to Engineering Notation
Q1.3.2 Resistor color code.	• Interpret color code for multiple resistance value and resistor type • Identify resistors by color code. • Measure the value of resistance using an ohm meter.

Q1.3.3 Digital Multi-meter (DMM)	• Demonstrate a DMM to measure resistance of:
	  ○ Resistors
	  ○ Conductors
	  ○ Insulators
	  ○ Semiconductors
	• Demonstrate a DMM to measure voltage using;
	  ○ Power supply
	  ○ Batteries
	• Demonstrate a DMM to measure current in a simple circuit.
	• Diagnose any given circuit using an DMM.

Q1.3.4 DC power supply.	• Understand common DC power sources.
	  ○ Batteries
	  ○ Adjustable DC power supply
	• Verify output voltage using a DMM meter.
	• Configure and connect adjustable DC power supply to a simple circuit.

Q1.3.5 Ohms Law	• Explain the three basic forms of Ohm's Law
	• Calculate voltage, current and resistance in a circuit using Ohms Law
	• Apply the concepts of Ohm's Law.
	  ○ Voltage
	  ○ Current
	  ○ Resistance

Q1.3.6 Series circuit	• Explain the Principal of Series circuit.
	  ○ Total resistance
	  ○ Total Voltage
	  ○ Total current
	• Troubleshoot a series circuit using resistance, voltage and current to determine functionality.
	  ○ Ohms law
	  ○ Kirchhoff's law

Q1.3.7 Parallel circuits	• Explain the Principal of Parallel circuit.
	  ○ Total resistance
	  ○ Total Voltage
	  ○ Total current
	• Troubleshoot a Parallel circuit using resistance, voltage and current to determine functionality.
	  ○ Ohms law
	  ○ Kirchhoff's law

Q1.3.8 Series - Parallel combination circuits.	○ Explain the Principal of Series - Parallel circuit. ○ Total resistance ○ Total Voltage ○ Total current ○ Troubleshoot a Series - Parallel circuit using resistance, voltage and current to determine functionality. ○ Ohms law

	○ Kirchhoff's law
Q1.3.9 Oscilloscope DC Usage	• Understand Display screen and controls. • Analyze a DC circuit Voltage vs Time.
Q1.3.10 Oscilloscope AC Usage	• Explain the difference between voltage RMS, VP, and Hz. • Apply the oscilloscope to measure the frequency and amplitude of various AC signals. • Compare and contrast the DMM and Oscilloscope to measure effective voltage (RMS), voltage peak and frequency of an AC sine wave.

Q1.3.12 Series - Parallel combination AC circuits.	• Explain the Principal of series – Parallel AC circuit.
	  • Total resistance
	  • Total Voltage
	  • Total Current
	• Troubleshoot a Series – Parallel circuit using resistance, voltage and current to determine functionality
	• Apply Ohm's Law
	• Apply Kirchhoff's law

Q1.3.13 Electrical Symbols	• Explain common Electrical / Electronic symbols. • Create a simple electrical /electronic schematic.
Technical Vocab- Direct current (DC) DC power supply, Battery, Voltage, Current, Resistance, Series circuit, Parallel circuit, Ohms law, Kirchhoff's law, Electromagnet, Conductor, Insulator, Short Circuit, Switch, Volt, Voltage.	
Resources- Industrial Maintenance and Mechatronics 2nd Edition	

Priority Standard Q2.1: Mechanical Systems

Big Idea(s):

- Mechanical systems are used in the production process.
- Without accurate measurement, modern industry could not exist.
- Complex equipment is a combination of many Simple Machines.

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Essential Question(s):

- What are mechanical Fasteners?
- Why are accurate measurements important needed to repair of equipment?
- What are the four (4) Simple Machines?
- Does the diameter of a gear influence speed?

Learning Outcomes

Students will:	As evidenced by: (Oral, written, or performance):

Q2.1.1 Fasteners	• Identify basic fasteners and explain the proper use
	  ○ Nuts / Bolts
	  ○ Wood screws
	  ○ Sheet metal screws
	  ○ Pop rivets
	• Demonstrate the use of Threaded Fasteners
	  ○ Bolts and screws
	  ○ Nuts
	  ○ Thread Terminology
	• Create mechanical threads with the use of Taps and Dies.

Q2.1.2 Measurement tools	• Demonstrate the use of:
	  ○ Ruler / Tape measure
	  ○ Micrometer,
	  ○ Dial Caliper,
	  ○ Dial indicator.

Q2.1.3 Levers	• Demonstrate the use of different classes of levers
	  ○ First class Lever
	  ○ Second class Lever
	  ○ Third class Lever
	  ▪ Load
	  ▪ Force
	  ▪ Fulcrum

Q2.1.3 Inclined planes	• Construct an inclined plane. • Describe the advantage gained by an Inclined plane.
Q2.1.4 Wheels and Axles	• Construct and explain a wheel and axle combination
Q2.1.5 Pulleys	• Describe the use and operation of pulleys in various Mechatronics Technology systems • Construct a pulley system

Q2.1.6 Gears	• Identify various types of gears.
	
	• Explain the differences
	  • Ring Gear
	  • Beveled Gear
	  • Sector Gear
	  • Worm Gear
	  • Planetary Gear
	
	• Build a simple gear train to study how they affect power
	  • Ring gear
	  • Beveled gear
	  • Sector gear
	  • Worm gear
	  • Planetary

Q2.1.7 Gear trains	• Identify the three functions of gear trains.
	  • Direction
	  • Speed
	  • Rotational Power
	
	• Identify the four classification of gear trains
	  • Simple
	  • Compound
	  • Reverted
	  • Planetary

	• Explain and Apply gear ratios • Gear ratio= #of teeth input(driving) / # of teeth output (driven)
Q2.1.8 Chain and sprocket drive	• Demonstrate and explain the operation of Chain and Sprocket drive systems. • Explain the similarities and differences of a gear train. • Build a chain and sprocket drive system.
Q2.1.9 Stepped pulley and belt system	• Explain how a stepped pulley system works. • Describe uses for stepped pulley systems • Identify the idler pulley in a stepped pulley system • Construct and demonstrate a stepped pulley system and demonstrate the advantages of its use

Q2.1.10 Block and tackle system.	• Identify components of a block and tackle system
	• Explain the block and tackle systems
	  • Single Block
	  • Double Block
	  • Double
	  • Gyn
	  • Three-Fold Purchase
	• Construct several different types of block and tackle systems and explain the function of each
	  • Single block
	  • Double block
	  • Force
	  • Load
	  • Movable and stationary blocks

Q2.1.11 Cams	• Identify cams
	  • Plate
	  • Grooved
	  • Cylindrical or Barrel
	• Describe how a cams shape causes linear motion
	• Explain the function of the follower arm
	• Graph the linear motion of a simple cam

Q2.1.12 linkages	• Label the parts of the linkage systems
	
	• Build the following linkages
	  • Crank Rocker
	  • Drag link
	  • Double rocker

Technical Vocab- Critical thinking, Backlash, Belt, Chain Pitch, Clearance Gearbox, Pinch point, pitch, pulley, sprocket, worm drive, worm gear, Newton, Inclined Plane, Kinetic Energy, Potential Energy, Torque, Wedge, Wheel and Axil, Friction, Force, Power.	
Resources- Industrial Maintenance and Mechatronics 2nd Edition	

Priority Standard Q2.2- Industrial Wiring Practice	
Big Idea(s): The proper wiring practices is essential to the safety of life and property.	
Essential Question(s): • What is the proper method to terminate wires? • How is wire sized correctly? • What is a GFCI and its purpose?	
Learner Outcomes	
Students will know:	**As evidenced by (Oral, written, or performance):**

Q2.2.1 Soldered splices.	• Explain each kind of soldered splices
	  • Pig tail
	  • Western union
	  • Tee-tap

Q2.2.2 Ground fault circuit interrupter (GFCI)	• Explain how a GFCI is used in an electrical circuit to prevent injury • Wire a circuit with two lights on the line side of a GFCI receptacle, and a light and a receptacle on the load side.
Q2.2.3 Single Pole switches for lighting circuit control.	• Identify the various types of toggle switches for lighting circuit control • Wire an electrical circuit using a single pole switch with the feed at the switch, and another circuit with the feed at the light.
Q2.2.4 Single pole and double pole switch.	• Explain the difference between a single pole and double pole switch • Wire an electrical circuit with an outlet controlled by a single controlled switch with a live receptacle outlet and feed at the switch.
Q2.2.5 Three-way switch Circuit.	• Describe how three-way switches are used • Connect a circuit with three-way switch control.

Q2.2.6 Multi position lighting circuits • **Three-way switches.** • **Four-way switches.**	• Build a lighting circuit with switch control at two different locations. • Describe how four-way switches are used and how they are different from three-way switches • Build a lighting circuit with switch control at three different locations.
Q2.2.7 Residential circuits	• Wire two three-way switches controlling two lighting outlets. The receptacle outlet is "live" at all times. • Wire a circuit with one switch controlling one lighting outlet. The other switch controlling the other lighting outlets. The receptacle outlets are “live” at all times. • Construct a circuit with a single-pole switch controlling a GFCI receptacle and a pilot light.
Q2.2.8 Dimmer switches	• Explain how and where dimmer switches are used on a written and/or oral assessment • Construct one circuit with a single pole dimmer controlling a light, and another circuit with a 3-way dimmer and a 3-way switch controlling a light.
Q2.2.9 Doorbell circuitry	• Wire a low-voltage step down transformer in a 4" square box and wire two-tone chimes so that the customer can tell whether the bell is ringing at the front door or the rear.
Q2.2.10 Photoelectric control switches	• Describe how and where photoelectric control switches are used • Using a photocell in an AC circuit. Connect a photocell to a light and outlet
Technical Vocab- Single pole, double pole 3-way ,4-way switches, Transformer, Primary tap, Secondary tap, National Electrical code, Busbar, Wire Diagram, UL.	
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Priority Standard Q2.3 AC / DC Motors	
Big Idea(s): • AC and DC motors are the prime movers for machinery. • The information listed on a motor nameplate is essential for proper installation and maintenance.	
Essential Question(s): • How does an AC motor operate? • How does a DC motor operate? • What is the difference between a Single phase and Three-phase motor?	
Learner Outcomes	
Students will know:	**As evidenced by (Oral, written, or performance):**
Q2.3.1 DC motor.	• Describe where DC motors are found • Explain the information found on a motor nameplate • Identify the types and parts of a DC motor. • Contrast the operating principles of a series-wound and shunt-wound DC motor

Q2.3.2 Single-phase motors	• Describe where Single-phase motors are found and explain the information found on a motor nameplate
	• Label motor leads T wire for forward and revise rotation
	• Label motor leads T wire for high and low voltage connections
	• Identify the parts of a single-phase motor.
	  • Conduction motors
	  • Induction motors
	  • Stator
	  • Rotor

Q2.3.3 Single-phase capacitor-start motor.
• **Capacitor-run induction motor.**
	• Explain the difference between a
	  • single-phase capacitor-run motor
	  • single-phase capacitor-start motor

	• single-phase capacitor-start motor • capacitor-run induction • Compare and Contrast between starting current and starting torque of capacitor-start motors. • Explain how the efficiency of a capacitor-start motor changes with load.
Q2.3.4 Motor bearings	• Identify types of motor bearings • Replace bears on a motor.
Q2.3.5 Three-phase induction motor.	• Explain the operation and connection methods of a three-phase induction motor
Q2.3.6 Shaded Pole Motors and Universal Motors.	• Explain the difference between o Shaded Pole Motors o Universal Motors
Q2.3.7 Servo motor and stepper motor	• Describe the following motor operations o Servo motor o Stepper motor.
Technical Vocab- Series motor, Shunt motor, compound motor, Induction, capacitive start, capacitive run, power rating, forward/reverse, High/low voltage connection, Roller bearing, Ball bearing. Inner race, Outer race.	
Resources- Industrial Maintenance and Mechatronics 2nd Edition	

Priority Standard Q2.5: Total Preventative Maintenance	
Learning Outcomes	
Big Idea(s): • **When a machine is running at peak performance, energy will be conserved.**	
Essential Question(s): • Why are preventative maintenance records important? • Does preventative maintenance on tools necessary?	
Students will know:	**As evidenced by:** **(Oral, written, or performance):**
Q2.5.1 Maintenance Methods • **Proactive Maintenance** • **Reactive Maintenance**	• Determine Proactive Maintenance processes. • Determine Reactive Maintenance processes.
Q2.5.2 Operation and Maintenance Documentation	• Complete a Daily maintenance checklist • Create a Machine Safety Checklist. • Implement a standard Work Order request.

Q2.5.3 Commonly used hand tools for maintenance and repair work.	• Identify and describe each common hand tool.
	  ○ Wrenches
	  ○ Hacksaws
	  ○ Files
	  ○ Sockets
	  ○ Torque Wrench
	  ○ Hex Keys
	  ○ Screwdrivers
	  ○ Pliers, Cutters
	  ○ Wire Strippers
	  ○ Hammers
	  ○ Pullers
	  ○ Chisels / Punches
	  ○ Power Tools
	• Demonstrate the safe use and care of all appropriate tools.

Technical Vocab- Preventative Maintenance, Standard Operating Procedure, Root Cause Analysis, Work Order, Proactive Maintenance, Reactive Maintenance, Wrench, Breaker Bar, Pliers, File, Hammer, Hex keys,	
Resources- Industrial Maintenance and Mechatronics 2nd Edition	

Priority Standard Q3.1 Motor control	
Big Idea(s): • Motor controls start, stop, regulate speed, and change electrical rotation.	
Essential Question(s): • What is the function of a Relay? • What are two reasons Overloads trip? • What are the symbols for a Normally Open and Normally Closed contact?	
Learner Outcomes	
Students will know:	**As evidenced by (Oral, written, or performance):**
Q3.1.1 Relay logic Diagrams	• Create a relay logic diagram using normally open (NO) and normally closed (NC) inputs • Identify the elements of a Relay ladder logic diagram

Q3.1.2 Overloads	• Explain the types of Overloads
	  • Thermal
	  • Magnetic
	• Determine proper sizing of Overloads

Q3.1.3 Transformers	• Explain turns ratio and primary secondary ratio and how they align • Determine the relationship of a transformers turns ratio to its primary and secondary voltage and current via live measurements
Q3.1.4 The Relay	• Operation and required electrical values for a relay to function as designed • Measure a relay to determine the coils resistance, contacts and current required to energize and hold the relay armature
Q3.1.5 Two-Wire Control	• Demonstrate the operation of a relay and motor by means of a switch
Q3.1.6 Three-wire control	• Summarize a pushbutton (Three-wire) control of relays and motors
Q3.1.7 Mechanical relay	• Identify the use of a mechanically held relay to control a lighting load.

Q3.1.8 Hand-off-auto (HOA) switch • **Toggle switch**	• Demonstrate a selector switch (H.O.A.) and a toggle switch to operate a relay and a load.
Q3.1.9 Multiple pushbutton station.	• Design and wire multiple pushbutton station in control situations.
Q3.1.10 Motor Sequence Controls	• Design and wire a sequence control circuit of multiple motor.
Q3.1.11 Contact interlock starter • **Forward** • **Reverse** • **Auxiliary**	• Develop a wire circuit using a forward and reverse motor and auxiliary contact interlock starter.
Q3.1.12 Relay logic circuits	• Paraphrase a relay logic diagram and interpret the function of the rung using the standard relay logic rules.
Q3.1.13 Fuses and Circuit breakers	• Explain the purpose of fuses and circuit breakers • Calculate the size a fuse or Circuit breaker for proper circuit protection. • Troubleshoot a fuse or Circuit breaker

Q3.1.14 Timers	• Determine the different timer option
	• Wire a circuit using the following timers
	  • Mechanical
	  • Digital

Technical Vocab- Critical thinking, auxiliary contact, normally closed, normally open, Relay, contactor, Motor starter, Interlocking, On delay timer, Off delay timer, NEMA, Relay logic.	
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Priority Standard Q3.2: Fluid Power Pneumatics	
Big Idea(s): The control of Compressed Air-Pneumatics is essential in the control of machinery.	
Essential Question(s): • What is the symbol used in the drawing of Pneumatic circuit? • Why is it important to Identify the components of a pneumatic circuit? • How will a technician troubleshoot a pneumatic circuit?	
Learning Outcomes	
Students will:	**As evidenced by:** **(Oral, written, or performance):**

Q3.2.1 Pneumatic system	• Describe and identify the basic components of a pneumatic system and their purpose
	  • Motor
	  • Compressor
	  • Receiver
	  • Air Filter
	  • Regulator

Q3.2.2 Pneumatic circuit Air Flow	• Explain air flow from the air storage tank to the pneumatic circuit.
Q3.2.3 Pressure regulator	• Demonstrate the use of a pressure regulator to control system air pressure.
Q3.2.4 Needle valve.	• Explain the operation and applications of the needle valve • Operate a needle valve in a simple pneumatic circuit.
Q3.2.5 Flow meter	• Describe the function of a flow meter • Install and read a flow meter in a simple pneumatic circuit.
Q3.2.6 Directional control valves (DCV).	• Explain the operation of the directional control valves (DCV) • Install and operate a manual directional control valve in a simple pneumatic circuit.

	• Install and operate a solenoid directional control valve in a simple pneumatic circuit. • Install and operate an air piloted directional control valve in a simple pneumatic circuit.
Q3.2.7 Flow control valve	• Explain the function of a flow control valve • Install and operate a flow control valve in a simple pneumatic circuit.
Q3.2.8 **Pneumatic cylinders.**	• Explain the function of single and double acting cylinders • Install and operate a single and double acting cylinder in simple pneumatic circuits.
Q3.2.9 Pneumatic circuit lubricators	• Explain the function of a lubricator in a pneumatic circuit • Install and operate a pneumatic lubricator.
Q3.2.10 Pneumatic air-treatment system.	• Describe common components a pneumatic air-treatment system • Install and operate an air filter in a pneumatic system.
Q3.2.11 Venturi vacuum generator	• Describe the function of a venturi vacuum generator in a pneumatic circuit • Install and operate a venturi vacuum generator in a pneumatic circuit.
Q3.2.12 Electro-Pneumatic system	• Explain the use of an Electro-Pneumatic system • Locate and identify the components of the Electro-Pneumatic system. • Construct and test a pneumatic circuit using a DCV connected to a cylinder. • Install and operate a two-cylinder sequencing circuit.
Q3.2.13 Pneumatic symbols	• Draw common symbols for valve and valve actuators • Identify common elements of a pneumatic cylinder • Create a simple pneumatic schematic.
Technical Vocab- Pressure, Flow, Regulator, Check valve, Manual valve, Air piloted valve, Solenoid valve, Air preparation.	
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Priority Standard Q3.3: Fluid Power Hydraulics

Big Idea(s):

- Fluid is the best material to transmit force.

Essential Question(s):

- What is the symbol used in the drawing of a Hydraulic circuit?
- What are the four (4) major components of a Hydraulic circuit?
- What are the three (3) types of hydraulic pumps used in a circuit?

Learning Outcomes

Students will:	As evidenced by: (Oral, written, or performance):

Q3.3.1 Hydraulic system	• Explain and identify the basic components of a hydraulic system pump
	  • Reservoir
	  • System Pressure Gauge
	  • Pressure Control Valve

Q3.3.2 Hydraulic circuit.	• Describe fluid flow from the reservoir to the hydraulic circuit.
Q3.3.3 Fluid power system.	• Describe the various functions a hydraulic fluid performs in a fluid power system

Q3.3.4 Hydraulic fluid
• **Contaminant**
• **Filter**
• **Strainer**
	• Identify common hydraulic fluid contaminants and explain the operation of a filter and strainer.
	  • Dust
	  • Moisture
	  • Metal shavings
	  • Litter, carbon particles
	  • Tiny particles from moving parts

Q3.3.5 Hydraulic pumps	• Identify different types of hydraulic pumps, and explain their purpose. • Gear pump • Vane pump • Piston pump

Q3.3.6 Pressure regulators / Pressure relief valves.	• Explain the functions of pressure regulators and pressure in a hydraulic system relief valve • Use a pressure regulator to control system fluid pressure.
Q3.3.7 Manual directional control valve	• Explain the function of a manual directional control valve in a hydraulic system • Construct and operate a manual directional control valve in a simple hydraulic circuit.
Q3.3.8 Check valves	• Explain how check valves are used in hydraulic circuits • Demonstrate the operation of a check valve in a simple hydraulic circuit.
Q3.3.9 Needle valve	• Describe the function of a needle valve • Install and operate a needle valve in a simple hydraulic circuit.
Q3.3.10 Hydraulic cylinder.	• Explain the operation of a hydraulic cylinder • Install and operate a hydraulic cylinder in a simple hydraulic circuit.
Q3.3.11 Valve Symbols	• Draw common symbols for valve and valve actuators • Identify common elements of a hydraulic cylinder Create a simple hydraulic schematic.
Technical Vocab- Pressure, Flow, Regulator, Check valve, Manual directional control valve, Solenoid directional control valve, Fluid preparation.	
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Priority Standard Q3.4 - Electronic Devices	
Big Idea(s): • At the most basic level, all modern electronic circuits are composed of passive components. • Understanding basic electronic components will help with the troubleshooting of more complex circuitry.	
Essential Question(s): • How can understanding the operations of basic circuits help with troubleshooting complex electronic circuits? • In DC circuits, how can voltage & current be controlled by using basic passive components to obtain desired conditions?	
Learner Outcomes	
Students will know:	**As evidenced by (Oral, written, or performance):**
Q3.4.1 Diode	• Explain the front to back resistive ratio of a solid-state diode • Determine the front to back resistive ratio of a solid-state diode using test equipment during lab experiments
Q3.4.2 Half wave rectifiers	• Explain how diodes can convert AC to DC and examine the half wave rectifiers waveforms • Determine that diode can convert AC to DC and examine the half wave rectifiers waveforms using test equipment during lab experiments
Q3.4.3 Full wave rectifiers	• Explain how diodes can convert AC voltages to DC and examine full wave rectifiers output waveform and voltage • Determine that diode can convert AC voltages to DC and examine full wave rectifiers output waveform and voltage via lab experiments

Q3.4.4 DC filter	• Explain the use of the capacitor as a DC filter
Q3.4.5 Bipolar transistor	• Explain the resistance values associated with a silicon bipolar transistor • Measure the resistance of a silicon bipolar transistor
Technical Vocab- Conductor, Insulator, Diode, LED, N-Type, P-Type, Doping, Boron, Arsenic, Depletion region, RMS, Average, PN Junction, Anode, Cathode, Forward Bias, Reverse Bias, Power Supply, Rectification, ½ wave, Full wave, Filtered, Ripple, Regulation, Valence Shell,	
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Priority Standard Q3.5: Total Preventative Maintenance	
Learning Outcomes	
Big Idea(s): • **When a machine is running at peak performance, energy will be conserved.**	
Essential Question(s): • What roll does test equipment play in preventative maintenance? • Does preventative maintenance down time reduce machine production? • Should equipment components be replaced before they break?	
Students will:	**As evidenced by:** **(Oral, written, or performance):**
Q3.5.1 Troubleshooting methods	• Demonstrate troubleshooting methods for: ○ Lubrication systems ○ Pneumatic systems ○ Hydraulic systems ○ Mechanical systems ○ Electrical systems.
Q3.5.2 Advanced diagnostic tools	• Demonstrate the use of: ○ Thermal Imaging Camera ○ Ultrasonic Leak Detector
Technical Vocab- Thermal, Thermal Imaging Camera, Digital Multimeter, Oscilloscope, root cause, Ammeter	
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Priority Standard Q4.1: Digital logic

Big Idea(s):

- **Digital logic gates open and close only when the data is correct.**

Essential Question(s):

- Why is the use of a logic probe preferred over a DMM when analyzing and troubleshooting digital circuits?
- How can the 5 logic gates, their truth tables, symbols and Boolean expressions help you as a technician?
- How are Logic Gates used in programming?

Learning Outcomes

Students will know:	As evidenced by: (Oral, written, or performance):
Q4.1.1 Logic Probe	The student demonstrates the use of a logic probe to troubleshoot a logic gate

Q4.1.2 Digital logic Gates	• Describe the operation of and construct truth tables for the logic gates
	  • Inverter
	  • AND
	  • OR
	  • NAND
	  • XOR
	• Demonstrate the operation and characteristics of a TTL logic gate and to show how it can be used to perform any of the basic logic functions.

Q4.1.2 truth tables: • RS flip-flops • D-type flip-flops • JK flip-flops	• Explain the operation of and construct truth tables for digital flip-flops • Demonstrate the operation and characteristics of a set-reset (latch) flip-flop, D type flip-flop, storage register, and JK flip-flop. (3.4 - 3.6)

Technical Vocab – Logic Gates, Pull-up resistor, pull-down resistor, inverter

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Priority Standard Q4.2: Automated Control Systems	
Learning Outcomes	
Big Idea(s): • **Control systems receive data and generate machine instructions.** • **Control systems are the brains of the assemble machine.**	
Essential Question(s): • **What are the main elements of a PLC?** • **What is the function of a PLC?** • **How are PLC's commands generated?**	
Students will:	**As evidenced by:** **(Oral, written, or performance):**
Q4.2.1 Programmable Logic Controller (PLC)	• Describe what a PLC is and list its advantages over relay systems

Q4.2.2 Programmable Logic Controller (PLC) Component's	• Know the main parts of a Programmable Logic Controller (PLC) and explain their functions
	  • Processor
	  • Memory Devices
	  • I/O (Input/Output)
	  • Power Supply
	• Identify the three basic sections of a programmable logic controller
	• List several applications of a programmable logic controller.

Q4.2.3 Programmable Logic Controller PLC) Input /output Modules	• Explain the difference between a sinking and sourcing input module
Q4.2.5 Relay ladder schematics	• Explain and demonstrate relay ladder schematics and how to convert them to ladder logic programs • Explain the steps of creating, editing and testing simple PLC programs utilizing the Relay Logic Instructions supported by RS Logix.
Q4.2.6 PLC ladder logic programs. • **Write** • **Enter** • **Run** • **Save**	• Write, enter, run, and save ladder logic programs • Create a sample program using the computer software.
Q4.2.7 RS Logic programing software	• Describe the features of RS Logic software and the steps in using RS Logic programming software.

Q4.2.8 PLC Simple input/output program.	• Write a simple input/output program
Q4.2.9 PLC relay function • **Internal** • **External**	• Identify the function of internal and external relay instructions • Write a PLC program containing internal and external relay coils.

Q4.2.10 PLC Timers instruction	• Explain and describe how to convert PLC timers to ladder logic diagrams
	  • No retentive ON-delay
	  • Retentive ON-delay
	  • OFF-delay

Q4.2.11 PLC counter instructions.	• Describe the operation of PLC counter instructions
	• Apply counter functions count up, count down, and reset to create PLC ladder logic diagrams on a written and/or oral assessment.
	  • Count up
	  • Count down
	  • reset

Q4.2.12 PLC Combinations • **Counter functions** • **Timer functions**	• Interpret combinations of counter and timer functions to create PLC ladder logic diagrams

Q4.2.13 PLC troubleshooting	• List and describe specific PLC troubleshooting procedures
	  • Describe the problem
	  • Eliminate Variables
	  • Reproduce the problem
	  • Attempt to fix

Q4.2.14 Variable frequency Drive	• List and describe various application of a variable frequency drive • Draw a wiring schematic of a variable frequency drive • Create a simple program using a variable frequency drive.
Technical Vocab- Professionalism, Organization, Critical thinking, communication skills, motivation.	
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Priority Standard Q4.3: Sensor Technology

Big Idea(s):

- **The eyes, ears, and fingers of a machine are the sensors.**
- **Sensors convert a physical action into an electrical equivalent.**

Essential Question(s):

- **Name the categories of sensors.**
- **Why is a Light Curtain sensor ideal for Pinch Point machine areas?**
- **In what application would a Heat Sensor be beneficial?**

Learning Outcomes

Students will:	**As evidenced by:** **(Oral, written, or performance):**
Q4.3.1 Hall effect sensors	• Demonstrate the installation and use of hall effect sensors

Q4.3.2 Proximity Sensors	• Describe the usage of various proximity sensors
	  • Inductive Usage Installation
	  • Capacitive Usage Installation
	  • Photo electric Usage Installation
	  • Ultrasonic Usage Installation

Q4.3.3 Photo sensors	• Describe and demonstrate the Usage and Installation of various Photo sensors
	  • Tru-beam
	  • Retroreflective
	  • Diffuse

Q4.3.4 Temperature sensors	• Describe and demonstrate the Usage and Installation of various Temperature sensors
	  • Thermistors
	  • Resistance temperature detectors RTD

Q4.3.4 Pressure Sensors	• Describe and demonstrate the Usage and Installation of a pressure sensors.

Technical Vocab- Photo Sensor, Proximity Sensor, Temperature Sensors, Pressure Sensors, Hall Effect Sensors, True-beam, Retroreflective, Diffuse.

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Priority Standard Q4.4: Robotics

Big Idea(s):

- **Robots perform functions in a humanlike manner.**
- **Robots rarely make mistakes and are more precise than human workers.**
- **Industrial Robots are not humanlike in appearance.**

Essential Question(s):

- **How do we use robots in daily life?**
- **How can Robots increase productivity?**

Learning Outcomes

Students will:	**As evidenced by:** **(Oral, written, or performance):**
Q4.4.1 Robotics Terms.	• Define terms related to robotics with their correct definitions ▪ Appendage ▪ Material ▪ Program ▪ Robot ▪ Robotic ▪ Work cell ▪ Work envelope
Q4.4.2 Reprogrammable vs multifunctional robots.	• Contrast between reprogrammable and multifunctional robots • Identify robotic hardware components and software
Q4.4.3 Robot Applications	• List various applications of robots
Q4.4.4 Machine work envelope	• Explain the parts of a work envelope • Zero reference point • Reach • Stroke • Swing
Q4.4.5 Robotic control software. • **SCORBASE**	• Activate and use SCORBASE robotic control software. • Record, absolute positions. list, delete, save and load positions. Move the robot to recorded positions. • Write and edit a simple robot program.

Q4.4.6 Pick and Place task.	● Program the robot for a pick and place task.
Q4.4.7 Robotic safety devices	● Explain protective safety devices for robotic systems
Q4.4.8 Careers in the robotic industries with their duties.	Match various careers in the robotic industries with their correct duties on a written and/or oral assessment. ● Electrician ● Mechatronic Technician ● Electronic engineer ● Computer service technician ● Robotics technician
Q4.4.9 Robot commands • **Conditional** • **Unconditional** • **Move Commands** ○ **X-axes** ○ **Y-axes** ○ **Z-axes** • **Relative positions** • **Program loops** • **Subroutines**	● Enable the robotic system to read and respond to input signals, and use conditional and unconditional jump commands. ● Instruct the robot to move according to Joints and XYZ axes. ● Program robot tasks using relative positions. ● Create program loops using counters/variables (polling), and create conditional program loops. ● Create program subroutines, and use additional programming commands
Q4.4.10 output signals / output commands in a robotic program.	● Produce output signals using output commands in a robotic program.
Q4.4.13 classification of robots according to their motion control.	● Explain the classification of robots according to their motion control on a written and/or oral assessment. • Pick and place • Point to point • Continuous path
Q4.4.15 Robot arm geometry.	● Identify the basic types of robot arm geometry on a written and/or oral assessment. • Rectangular • Cylindrical • Spherical • Jointed
• **Technical Vocab-** Rectangular, Cylindrical, Spherical, Jointed, Pick and place, Point to point, Continuous path, Joint XYZ axis, Yaw, Pitch, Roll	
Resources- Industrial Robotics Fundamentals 4th Edition G-W Publisher	

Priority Standard Q4.5: Total Preventative Maintenance	
Learning Outcomes	
Big Idea(s): • **When a machine is running at peak performance, energy will be conserved.**	
Essential Question(s): •	
Students will know:	**As evidenced by:** **(Oral, written, or performance):**
Q4.5.1 Green Maintenance	• Explain the benefits of Green Maintenance and the environmental impact to the world.

Q3.5.2 Recycling	• Explain and demonstrate the proper recycling methods for:
	  ○ Steel
	  ○ Batteries
	  ○ Oils

Technical Vocab- Green Maintenance, Recycling, Environment.	
Resources- Industrial Maintenance and Mechatronics 2nd Edition	