



Connecticut Technical Education and Career System

Robotics and Automation

Curriculum Guide

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CTECS - Vision of a Graduate
Connecticut Technical Education and Career System

Vision of a Graduate

A CTECS Graduate is...



A Problem Solver



Work Ready



Respectful



Skilled Socially



A Critical Thinker



An Effective Communicator

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

An Effective Communicator

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.

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.

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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
<p>Providing and Communicating Clear Learning Goals</p> <ol style="list-style-type: none"> 1. Providing scales and rubrics 2. Tracking student progress 3. Celebrating success <p>Using Assessments</p> <ol style="list-style-type: none"> 4. Using informal assessments of the whole class 5. Using formal assessments of individual students 	<p>Conducting Direct Instruction Lessons</p> <ol style="list-style-type: none"> 6. Chunking content 7. Processing content 8. Recording and representing content <p>Conducting Practicing and Deepening Lessons</p> <ol style="list-style-type: none"> 9. Using structured practice sessions 10. Examining similarities and differences 11. Examining errors in reasoning <p>Conducting Knowledge Application Lessons</p> <ol style="list-style-type: none"> 12. Engaging students in cognitively complex tasks 13. Providing resources and guidance 14. Generating and defending claims <p>Using Strategies That Appear in All Types of Lessons</p> <ol style="list-style-type: none"> 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 	<p>Using Engagement Strategies</p> <ol style="list-style-type: none"> 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 <p>Implementing Rules and Procedures</p> <ol style="list-style-type: none"> 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 <p>Building Relationships</p> <ol style="list-style-type: none"> 38. Using verbal and nonverbal behaviors that indicate affection for students 39. Understanding students' backgrounds and interests 40. Displaying objectivity and control <p>Communicating High Expectations</p> <ol style="list-style-type: none"> 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 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

Grade 9 – Semester 1 & 2 DSA

[9.1 - Shop Safety](#)

[9.2 - Career Readiness/Exploration](#)

[9.3 - Basic Hand Tools, Soldering, and Solderless Connection Techniques](#)

[9.4 - Drones & Avionics Applications I](#)

[9.5 - Math, Schematics, & Computer Applications I](#)

[9.6 - Introductory Robotic & Automation Components](#)

[9.7 - 3D Printing and Design I](#)

[9.8 - Instrumentation /Metering I](#)

[9.9 - Fundamentals of Robotics & Simple Machines I](#)

[9.10 - Robotics & Manufacturing Applications I](#)

[9.11 - Assembly & Projects I](#)

Grade 10 – Semester 1 DSA

[10.1 - Shop Safety](#)

[10.2 - Magnetism & Electromagnetic Devices](#)

[10.3 - Print Reading, Math & Computer Applications II](#)

[10.4 -Instrumentation/Meters II](#)

[10.5 - Sensors & End-of-Arm Tooling](#)

[10.8 - Assembly & Projects II](#)

Grade 10 – Semester 2 DSA

[10.1 - Shop Safety](#)

[10.3 - Print reading, Math & Computer Applications II](#)

[10.4 - Instrumentation/Meters II](#)

[10.6 - Digital Circuits & Programmable Logic Controllers \(PLC's\) I](#)

[10.7 - Robotics & Manufacturing Applications II](#)

[10.8 - Assembly & Projects II](#)

Grade 11 – Semester 1 DSA

[11.1 - Shop Safety](#)

[11.2 - Math, Schematics & Computer Applications III](#)

[11.3 –Instrumentation/Meters III](#)

[11.4 - Digital Circuits & Programmable Logic Controllers \(PLC's\) II](#)

[11.5 Pneumatic Systems & Devices in Automation](#)

[11.7 - Robotics & Manufacturing Applications III](#)

[11.8 Assembly & Projects III](#)

Grade 11 – Semester 2 DSA

[11.2 - Math, Schematics & Computer Applications III](#)

[11.3 -Instrumentation/Meters III](#)

[11.4 - Digital Circuits & Programmable Logic Controllers \(PLC's\) II](#)

[11.5 Pneumatic Systems & Devices in Automation](#)

[11.6 Hydraulic Systems & Devices in Automation](#)

[11.7 - Robotics & Manufacturing Applications III](#)

[11.8 Assembly & Projects III](#)

Grade 12 – Semester 1 DSA

[12.1 - Shop Safety](#)

[12.2 - Math, Schematics & Computer Applications IV](#)

[12.3 - Advanced HMI's & SCADA Systems II](#)

[12.4 - Digital Circuits & Programmable Logic Controllers \(PLC's\) III](#)

[12.6 - Industrial Networking](#)

[12.7 - Industrial Data Collection](#)

[12.8 - Robotics & Manufacturing Applications IV](#)

[12.9 - Robotics & Automation Assembly & Projects IV](#)

Grade 12 – Semester 2 DSA

[12.2 - Math, Schematics & Computer Applications IV](#)

[12.3 - Advanced HMI's & SCADA Systems](#)

[12.5 - Motor Controls](#)

[12.8 - Robotics & Manufacturing Applications IV](#)

[12.9 - Robotics & Automation Assembly & Projects IV](#)

9th Grade Curriculum

Priority Standard 9.1 - Shop Safety

Big Idea(s):

- Safety is the responsibility of everyone in the shop.
- Knowing emergency procedures and first aid saves lives.

Essential Question(s):

- Why are professional conduct and safe work habits essential for success in the robotics and Automation trade?
- Why is it important to understand and follow SDS information when working with chemical or hazardous materials?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

9.1.1 Workplace Safety

- Follow awareness strategies.
- Identify Workplace Safety Hazards.
- Explain Student Rights and Laws.(VOG-Respectful)
- Score 100% on a written safety test.(VOG-Critical Thinker)

9.1.2 Safe Work Habits

- Identify Personal Protective Equipment (PPE).
- Demonstrate appropriate PPE use.
- Explain the importance of Professional Conduct / Work Ethic.
- Explain the importance of SDS (Safety Data Sheets) in the shop.
- Follow shop safety rules. (VOG - Work Ready)
- Maintain a clean work area/shop. (VOG - Work Ready)
- Locate Emergency shut-offs in shops.
- Score 100% on a written safety test.(VOG-Critical Thinker)

9.1.3 General First Aid

- Describe procedures for dealing with various injuries.
- Locate Eyewash station.
- Locate Automated External Defibrillator (AED)

	<ul style="list-style-type: none"> ● Explain the dangers of bloodborne pathogens. ● Identify who to contact in case of a first aid/emergency situation. (VOG - An Effective Communicator) ● Score 100% on a written safety test.(VOG-Critical Thinker)
<p>9.1.4 Electrical Safety</p>	<ul style="list-style-type: none"> ● Explain the difference between current or voltage? ● Identify factors that determine the degree of damage when electrocuted. ● Describe ventricular fibrillation. ● Describe procedures for dealing with electrical shock. ● Score 100% on written safety test. (VOG-Critical Thinker) ● Compare & Contrast Circuit breakers & fuses. ● Identify Fuse types and ratings. Identify Circuit breaker types and ratings.
<p>9.1.5 Ladder Safety</p>	<ul style="list-style-type: none"> ● Explain the safe use of ladders ● Identify components of a ladder. ● Score 100% on a written safety test. (VOG-Critical Thinker)
<p>9.1.6 Tools & Equipment</p>	<ul style="list-style-type: none"> ● Explain why tool selection for specific tasks is crucial for safety and efficiency. ● Identify storage options for tools to insure safety and organization.
<p>9.1.7 Robotic Safety Considerations</p>	<ul style="list-style-type: none"> ● Discuss safety practices related to tools and equipment. (VOG - Work Ready) ● Describe guidelines, barriers, sensors, and overload protection for robotics safety. ● Identify maximum, restricted, & operating spaces of robots. ● Compare and contrast physical barriers with electronic sensor safety barriers.
<p>Technical Vocab- PPE, Dress Code, SDS, Fire Extinguisher. Bloodborne Pathogens, AED, Eye Wash Station, Emergency Shut-off, Current, Voltage, Resistance, Ventricular Fibrillation, , Ladder, Circuit Breaker, Fuse, Payload, Work Envelope, Barrier, Sensor,</p>	

Resources- District Mandated Safety Day curriculum and required documentation, District Safety Test, District Safety Quiz, laddersafetytraining.org. Chapter 3 of Industrial Robotics Fundamentals G-W, sample fuses & circuit breakers, Z-Space Robotic Safety Software.

<https://www.osha.gov/otm/section-4-safety-hazards/chapter-4>

Priority Standard 9.2 - Career Readiness/Exploration

Big Idea(s):

- **Employability skills are just as important as technical skills.**
- **Career readiness begins with understanding the opportunities available in robotics and automation.**

Essential Question(s):

- **Why are employability skills, such as professionalism, punctuality, communication, and organization, just as important as technical knowledge?**

Learning Outcomes

<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
9.2.1 Job Opportunities	<ul style="list-style-type: none"> ● Research job opportunities in Robotics & Automation ● List job requirements for entry-level employment in Robotics & Automation ● Identify Work Based Learning possibilities
9.2.2 Employability Skills	<ul style="list-style-type: none"> ● Demonstrate good attendance (VOG - Work Ready) ● Follow shop rules (VOG - Work Ready) ● Follow school and district rules (VOG - Work Ready) ● Demonstrate Professionalism (VOG - Work Ready) <ul style="list-style-type: none"> ○ Dress code ○ Readiness ○ Hygiene

Technical Vocab- Professionalism, Organization, Critical thinking, communication skills, motivation.

Resources- Career Development, SkillsUSA Framework Essentials/Career Readiness, Shop Rules, School Rules, Student Handbook, Teacher Modeling industry standards.

Priority Standard 9.3 - Basic Hand Tools, Soldering, and Solderless Connection Techniques

Big Idea(s):

- Safe and effective work begins with understanding tools and their purposes.
- Different soldering and connection methods serve different purposes.
- Knowing how to safely desolder is as important as knowing how to solder.

Essential Question(s):

- Why is it important to understand the purpose and proper use of each hand tool before beginning a task?
- How does soldering transform materials and components into reliable electrical connections?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

9.3.1 Hand Tool Identification and purpose

- **Identify and explain common hand tools**
 - Measuring tool
 - Marking Tool
 - Soldering Iron
 - Desoldering Pump
 - Solder wick
 - Screwdrivers
 - Pliers
 - Wrenches
 - Sockets
 - Drills (Electric / Battery)
 - Tap / Die
- **Compare and Contrast soldering methods**
 - Wires/Splices
 - Through Hole Printed Circuit Boards
 - Surface Mount Printed Circuit Boards
 - Solder Connectors
- **Demonstrate Visual tool inspection.**

9.3.2 Hand Tool Use

- **Explain the importance of using the appropriate tool for the job.**
- **Explain the dangers of using a damaged**

	<p>tool</p> <ul style="list-style-type: none">● Explain the importance of keeping tools sharp and clean● Demonstrate proper storage of tools.● Explain and demonstrate soldering iron tip Tinning/polishing to industry standards● Demonstrate safe use of hand tools● Score 100% on Written Safety Test(VOG-Critical Thinker)
<p>Technical Vocab- Ruler, Soldering Iron, Tin-Lead Ratio, Breadboard, Diagonal Cutter, Long nose plier, wire stripper, desoldering pump, hookup wire, solder wick, polishing stone, “tip tinning”, solder, Wrench, screwdriver, allen wrench, hex head, slip-joint, adjustable, socket, metric, imperial, die, tap,</p>	
<p>Resources- Industry Software/website, teacher hands on demonstrations, exemplars, TinkerCAD Circuits, textbooks, Soldering Irons, Components, Hand Tools, protoboard/kits or equivalent.</p>	

Priority Standard 9.4 - Drones & Avionics Applications I

Big Idea(s):

- Flight is governed by measurable forces and sensor driven adjustments.
- Every drone component has a specific purpose that contributes to safe and effective flight.
- Flight safety is both a legal and ethical responsibility.

Essential Question(s):

- How does understanding how the basic components of a drone work together to propel a smooth and effortless flight?
- What safety requirements must be met in order to fly safely?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

9.4.1 Drone Components

- Identify parts of a drone.
- Demonstrate the use of a Flight Controller.
- Explain how Gyroscopes, Accelerometers, Optical flow sensors and ToF range sensors control drone rotation.
- Explain how a barometer compares the atmospheric pressure to determine the drones altitude
- Explain how sensors can be discrete or analog
- Explain how roll, pitch and yaw affect the flight of a drone.

9.4.2 Drones

- Identify drone types and their use.
- Explain the advantages and disadvantages of done types.
- Assemble a drone from individual components.
- Program using Block/Python to maneuver the drone.
- Explain potential hardware/software malfunctions during drone flight.
- Implement corrective action on drone hardware / software.(VOG - Problem Solver & Critical Thinker)

9.4.3 Federal Aviation Administration (FAA)

- **Compare and contrast FAA certifications**
 - TRUST Certification
 - 107 Certification
- **Obtain FAA TRUST Certification.(VOG - Work Ready)**
- **Operate a drone safely.**

Technical Vocab- propeller, accelerometer, barometer, gyroscope, 3D infrared module, optical flow sensor, flight battery, Python and block coding, yaw, pitch, roll, gravitational force, Time of Flight Range Sensor, Optical flow sensor, FAA, TRUST, 107

Resources- LocoRobo website and curriculum, multimeters, drone curriculum, drone software, FAA website, Basic Operator TRUST certification.

Priority Standard 9.5 - Math, Schematics, & Computer Applications I

Big Idea(s):

- Every component in a schematic has a specific purpose that affects how a circuit behaves.
- Mathematical skills are essential tools for working in robotics and automation.
- Modeling systems builds deep comprehension of how robotics and automation function.

Essential Question(s):

- How do schematic diagrams help us understand, build, and troubleshoot electrical and robotics systems?
- How does Ohm’s Law help us predict and control the behavior of electrical systems?
- Why must technicians verify, test, and refine AI generated code rather than rely on it blindly?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

9.5.1 Schematic Diagrams

- **Identify schematic symbols:**
 - AC Power
 - DC Power
 - Fuse
 - Circuit Breaker
 - Ground
 - Switches (Mechanical, Magnetic, Proximity)
 - Sensors
 - Resistor
 - Diode
 - Transistor
 - Inductor
 - Capacitor
 - Stepper Motor
 - Servo Motor
 - Clock
 - Flip Flop
 - 7 Logic Gates
 - Solenoid
 - Lamp
 - IC’s

	<ul style="list-style-type: none"> ○ Other industry standards as needed. ● Construct basic robotic circuits. ● Create technical drawing that reflect verbal description. (VOG - Problem Solver) ● Create a flow diagram for a machine problem using industry standards (ISO 9001) ● Model a functioning robotic and automation system.
<p>9.5.2 Robotics & Automation Math I</p>	<ul style="list-style-type: none"> ● Convert between metric prefixes, metric & imperial units, common machining units (VOG - A Critical Thinker) ● Describe Ohm's Law and its mathematical expression ($V = IR$), where V is voltage, I is current, and R is resistance.
<p>9.5.3 Artificial Intelligence</p>	<ul style="list-style-type: none"> ● Introduce and verify sample AI code ● Create a basic scaffold program using AI. ● Identify & categorize items in an image or that are presented to camera system using AI
<p>Technical Vocab- Metric Prefixes, (milli, micro, nano, pico, Mega, Giga, Kilo, etc.) Schematic, Engineering Notation, Scientific Notation, Formula, 3D Printing, Microcontroller, Python, Basic, DoBot, Drone, Blockly, Z-Space</p>	
<p>Resources- Textbooks, online manuals, ETCAI Challenges, computer schematic software, Robotics Textbooks, TinkerCAD, AutoCAD, Solid Works, DoBot, Drone Software, Z-Space, Python, CodeHS Pro educational coding software, Parallax.</p>	

Priority Standard 9.6 - Introductory Robotic & Automation Components

Big Idea(s):

- Fasteners are foundational to all mechanical systems, ensuring that robotic structures remain secure, stable, and functional.
- Microcontrollers are the brains of robotic systems.
- Automation systems rely on the integration of power, control, logic, and feedback.

Essential Question(s):

- Why is it important to understand how different fasteners work in order to build safe, reliable, and maintainable robotic systems?
- How is programming in languages like Python, C ++. And Java allows humans to communicate instructions that robots can execute?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

9.6.1 Fasteners

- Identify basic fasteners and explain their proper usage and functions.
- Demonstrate the identification & use of Threaded Fasteners
- Demonstrate the usage of Bolts, screws, & Nuts
- Identify Key Thread Terminology
- Create mechanical threads with the use of Taps and Dies.

9.6.2 Basic Robot Devices

- Compare and Contrast AC and DC motors.
- Demonstrate how wheel size, material, and tread affect traction on different surfaces.
- Identify types of wheels used in robotics
- Integrate servos into robotic designs to control joints or movable parts.
- **Create a program using:**
 - Python
 - C++
 - Java

	<p>(VOG - A Problem Solver, A Critical Thinker, & Work Ready)</p> <ul style="list-style-type: none"> ● Explain Microcontrollers: <ul style="list-style-type: none"> ○ Brands ○ Features ○ Abilities ● Identify sensor types: <ul style="list-style-type: none"> ○ Proximity sensors ○ Gyroscope sensors ○ LiDar ○ GPS ○ Sound ○ Accelerometers ○ Vision sensors.
<p>9.6.3 Automation Components</p>	<ul style="list-style-type: none"> ● Explain how a power supply converts alternating current (AC) to direct current (DC) and regulates voltage and current output. ● Identify the key components of a PLC: <ul style="list-style-type: none"> ○ CPU ○ Input/output modules (I/O) ○ Memory, and programming interface. ● Write and upload programs using ladder logic. ● Evaluate program with Relay Logic - H-O-A. ● Diagnose and resolve communication issues: <ul style="list-style-type: none"> ○ Incorrect wiring ○ Protocol mismatches ○ Software bugs. <p>(VOG - An Effective Communicator)</p>
<p>Technical Vocab: Actuator, Sensor, Controller, PLC, Feedback Control, Power Supply, Programming Interface, Software Ladder Logic, Thread, Thread pitch, Servo, Touch Sensor, Proximity Sensor, Light Sensor, Sound Sensor, LiDar Sensor, GPS Sensor, Motor, Microcontroller, Servo, PWM, Relay.</p>	
<p>Resources- Textbooks, multimeters, power sources, CodeHS Pro educational coding software, manufacturer software and information sheets. , Robotic Trainers, DoBot, Z-Space computer simulations, Robotic Trainer Software, Automation Software, PLC's, Microcontrollers.</p>	

Priority Standard 9.7 - 3D Printing and Design I

Big Idea(s):

- CAD skills are essential for communicating engineering and manufacturing ideas.
- The operation of a 3D printer requires precision, safety, and attention to detail.

Essential Question(s):

- How does the design process transform an idea into a functional 3D model?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

9.7.1 Computer Aided Design

- **Create 3D models using CAD software.(VOG - A Problem Solver & A Critical Thinker)**
- **Describe basic CAD software functions**
- **Explain how to navigate and manipulate objects within the various CAD interfaces. (VOG - An Effective Communicator)**

9.7.2 3D Printer Basics

- **Identify different types of 3D printers and their capabilities.**
 - **Fused Deposition Modeling (FDM), which melts and extrudes plastic filament**
 - **Stereolithography (SLA) and Digital Light Processing (DLP), which use a UV light source to solidify liquid resin**
 - **Selective Laser Sintering (SLS), which uses a laser to fuse powder**
 - **Direct Metal Laser Sintering (DMLS), which is similar but uses metal powder**

	<ul style="list-style-type: none"> ● Explain the steps involved in preparing a 3D model for printing. <ul style="list-style-type: none"> ○ Leveling ○ Filament Type ○ Speed ○ Fill ○ Temperature ○ Raft <p>(VOG - Skilled Socially & An Effective Communicator)</p> <ul style="list-style-type: none"> ● Explain common materials used in 3D printing and their properties. (VOG - Skilled Socially & An Effective Communicator) ● Demonstrate the operation of a 3D printer. ● Evaluate a 3D printed object based on design specifications. (VOG - A Critical Thinker & A Problem Solver)
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Technical Vocab- Filament, Extruder, Layer Height, Infill, Supports, Bed Adhesion, Raft, Bed Leveling, Shape Generator, Alignment, Scale, Export, Workplane

Resources- TinkerCad website, Manufacturer / Software Resources directly from 3-D printer manufacturer such as Creality, Industry Software/website, textbooks, CAD software

Priority Standard 9.8 - Instrumentation/Metering I

Big Idea(s):

- **Accurate measurement is essential to understanding, troubleshooting, and safely working with electrical systems.**
- **Instrumentation expands a technician’s ability to evaluate, diagnose, and verify electrical circuits and components.**

Essential Question(s):

- **How do different types of measurement tools influence the accuracy, safety, and reliability of electrical testing?**

Learning Outcomes

<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
<p>9.8.1 Multimeters</p> <ul style="list-style-type: none"> ● Digital Multimeter (DMM’s) 	<ul style="list-style-type: none"> ● Identify common types, brands and functions of various instrumentation. ● Explain the advantages and disadvantages of measuring current, voltage, resistance, and power with different instrumentation. (VOG - An Effective Communicator) ● Demonstrate proficiency in selecting the proper settings, ranges and polarity for making electric measurements. ● Demonstrate measuring currents, voltages, and resistances to industry standards using a DMM safely. (VOG - Work Ready)
<p>9.8.2 Digital Multimeter Basics</p> <ul style="list-style-type: none"> ● DMM Certification 	<ul style="list-style-type: none"> ● Obtain certification from Fluke (or equivalent) for Digital Multimeters usage. (VOG - Work Ready) <ul style="list-style-type: none"> ○ Multimeter Orientation ○ Around the Dial ○ Advanced Measurement ○ Extending Capabilities ○ Choosing a Multimeter ○ Inspection and Maintenance

Technical Vocab- Test Leads, DMM,, Shunt, meter movements, fuse, limitation, Dial, Functions, scale, range, multiplier,

Resources- Fluke Website Certification, Textbooks, ETCAI Challenges, computer schematic software, multimeters, power sources, protoboard or equivalent.

Priority Standard 9.9 - Fundamentals of Robotics & Simple Machines I

Big Idea(s):

- **Robotics combines mechanical structure, electronics, and programming.**
- **Robot configurations influence workspace, accuracy, speed, and suitability for specific tasks.**

Essential Question(s):

- **How do the major components of a robot work together to allow a robot to perform tasks?**
- **How does robot configuration influence workspace, accuracy, adaptability, and suitability for specific tasks?**

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

9.9.1 Robot components

- **Identify and describe parts of a robot.**
 - **Controller**
 - **Manipulator**
 - **End Effector**
 - **Power Supply**
 - **Means for Programming**
- **Demonstrate assemble and dis-assemble of robots.**
- **Describe how sensors and actuators are integrated into the robot's programming to perform specific tasks or respond to environmental conditions. (VOG - An Effective Communicator)**

9.9.2 Degrees of Freedom

- **Describe Degrees of Freedom as it applies to:**
 - **Right-hand Rule in Robotics**
 - **XYZ - axis**
 - **Pitch**
 - **Roll**
 - **Yaw**
- (VOG - A Problem Solver). (VOG - An Effective Communicator & A Critical Thinker).**

9.9.3 Classifications of Robots

- **Identify types of robot classifications:**
 - **Industrial robots**

	<ul style="list-style-type: none"> ○ Service robots ○ Mobile robots ○ Humanoid robots ○ Collaborative robots (cobots) ○ Aerial robots (drones). ● Describe functions performed by each type of robot: <ul style="list-style-type: none"> ○ Manufacturing tasks for industrial robots ○ Assistance tasks for service robots ○ Exploration tasks for mobile robots. (VOG - An Effective Communicator) ● Identify and Describe Robot control systems: <ul style="list-style-type: none"> ○ Open-loop / non-servo ○ Closed-loop / Servo ● Identify and describe types of actuator drives: <ul style="list-style-type: none"> ○ Electric ○ Hydraulic ○ Pneumatic
<p>9.9.4 Robot configuration</p>	<ul style="list-style-type: none"> ● Identify and explain different configurations of robots. <ul style="list-style-type: none"> ○ Cartesian (X,Y,Z) ○ Spherical (Polar) ○ Revolute (Articulated) ○ Cylindrical ○ Speciality (VOG - An Effective Communicator) ● Compare and contrast robot configurations: <ul style="list-style-type: none"> ○ Workspace ○ Payload capacity ○ Speed ○ Accuracy ○ Adaptability ● Describe key design considerations when selecting a robot configuration for specific applications, including reachability, accessibility, rigidity, and energy efficiency.(VOG - An Effective

**Communicator, A Problem Solver, & A
Critical Thinker)**

Technical Vocab- Critical thinking, Pitch, Roll, Yaw, Manipulator, End Effector, Power Supply, Controller, Manipulator, End Effector, Joint, Servo Motor, Cartesian Robot, Articulated Robot, Autonomous Robots, Service Robots, Industrial Robots, Service Robots, Mobile Robots, Humanoid Robots, Aerial Robots, Chassis, Actuator, Servo Motor, Sensor, Wheels

Resources- Industrial Maintenance and Mechatronics 2nd Edition, simple/advanced machines trainer, G-W Industrial Fundamentals Theory and Applications 4th edition, drones, DoBot, Z-Space, Robotic Trainers.

Priority Standard 9.10 - Robotics & Manufacturing Applications I

Big Idea(s):

- All Modern Manufacturing is based on robotic processes that automate the production and delivery of goods and services.
- Understanding the basics of robotics and automation is necessary to design and repair robotics, computer driven manufacturing (CNC), or automation systems/services.

Essential Question(s):

- Why is robotics necessary when producing goods and services?
- How can automation help to produce goods and services?
- What Robotics & Automation devices are used today and what does the future look like?
- What possible education or career paths are available in robotics & automation?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

9.10.1 Robots - Manufacturing

- Compare and contrast Robotics vs. Automation.
- Explain advantages and Disadvantages of Robots in manufacturing:
 - Advantages
 - Productivity
 - Quality Control
 - Uniformity
 - Safety
 - Down Time
 - Flexibility
 - Disadvantages
 - Initial Cost/Investment
 - Production line Modifications
- Identify different types of robotics.
 - Manual Manipulator
 - Fixed-sequence robot
 - Variable-sequence robot
 - Playback robot
 - Numerically controlled (NC) robot

	<ul style="list-style-type: none"> ○ Intelligent Robot ● Identify different types of automation processes <ul style="list-style-type: none"> ○ Hard Automation ○ Flexible Automation ● Identify different types of robot communication interfaces <ul style="list-style-type: none"> ○ Digital Inputs ○ Digital Outputs ○ Serial Ports ○ Parallel Ports ● Compare and contrast autonomous and synchronization modes. ● Explore with Robotic Arms, Robotic Hands, VEX, DoBot, Conveyors, PLC Trainers, 3D printers. (VOG - An Effective Communicator, Skilled Socially, A Problem Solver, & A Critical Thinker)
<p>9.10.2 Automation</p> <ul style="list-style-type: none"> ○ Tasks (problem solving) ○ Multiple Process/Systems ○ Interfacing/Communications ○ Programming ○ Troubleshooting/Testing ○ Quality Control ○ System Efficiency Improvements ○ Career Pathways 	<ul style="list-style-type: none"> ● Simulate a manufacturing operation and automate using robotic arm, conveyor, and other sorting/sensing devices.(VOG - Skilled Socially & Respectful)
<p>9.10.3 Applications</p> <ul style="list-style-type: none"> ● Automated Manufacturing Factories ● Outside the Factory ● Artificial Intelligence 	<ul style="list-style-type: none"> ● Explore AI and how it is changing manufacturing for the better. ● Identify Cobots and Robots in daily life. (VOG - Skilled Socially & Respectful)
<p>9.10.4 Simple Machines</p>	<ul style="list-style-type: none"> ● Demonstrate the use of different classes of levers <ul style="list-style-type: none"> ○ First class Lever ○ Second class Lever ○ Third class Lever ○ Load ○ Force

	<ul style="list-style-type: none"> ○ Fulcrum (VOG - An Effective Communicator) ● Construct an inclined plane. ● Describe the advantage gained by an Inclined plane. (VOG - An Effective Communicator) ● Construct and explain a wheel and axle combination (VOG - A Problem Solver & Critical Thinker) ● Describe the use and operation of pulleys in various robotics systems ● Construct a pulley system (VOG - A Problem Solver & Critical Thinker) ● Construct a wedge system (VOG - A Problem Solver & Critical Thinker) ● Identify a screw system
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Technical Vocab- Robot, Automation, throughput, volume, speed, velocity, degrees of rotation, programming, VEX, Servo motor, stepper motor, conveyor, pneumatic, solenoid, valves, PSI, autonomous mode, synchronization mode, interfacing, relay, LED, infrared, hall effect sensors, transducer, optoisolator, hydraulics, 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 Axle, Friction, Force, Power.

Resources- Textbooks, PLC Software, Arduino/Parallax Hardware and software, Robotic Arm hardware and software, VEX hardware and software, FESTO conveyor, picker, and stacker hardware and software, CodeHS Pro educational coding software, DoBot, Drone, Z-Space virtual software, Simple Machine Mechatronic Trainer, Robotics Textbook,

Priority Standard 9.11 - Assembly & Projects I (Ongoing)	
Big Idea(s): <ul style="list-style-type: none"> • Incorporating all 9th grade goals is essential to success in the creation of robotics & automation projects. • Maintaining artifacts of work can build a robotics & automation technician's resume. 	
Essential Question(s): <ul style="list-style-type: none"> • What is the importance of "workmanship?" • How can a portfolio of projects built to industry standards of quality and professionalism, assist in obtaining a job? 	
Learning Outcomes	
<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
9.11.1 Robot and Automation Competencies: <ul style="list-style-type: none"> ○ Safety ○ Calculations ○ Schematics ○ Soldering & Hand Tools ○ Meters and Measurements ○ Troubleshooting and Repair ○ Drone Projects ○ Robotic Projects ○ Automation Projects ○ Written Analysis with conclusion/discussion of results 	<ul style="list-style-type: none"> • Obtain proficiency determined by a scoring rubric. <ul style="list-style-type: none"> ○ An 80% or greater on an individual project rubric would be considered proficiency in assembly. ○ Various: Written Analysis, Shop Presentation, Research Project, Research from Industry Partners, Computer Aided Instruction Software, Field Trips, etc. (VOG-Critical Thinker) <ul style="list-style-type: none"> • Demonstrate industry standard behaviors expected for career employability. (VOG - Work Ready, Respectful & Skilled Socially) • Demonstrate projects can be assembled to acceptable industry standards.(VOG - Work Ready, Respectful & Skilled Socially)
9.11.2 Robotics & Automation Portfolio	<ul style="list-style-type: none"> • Upload evidence of proficiencies completing various projects to portfolio
Technical Vocab- Written Analysis, Conclusion, Discussion of Results, competency, portfolio, resume, artifacts, evidence, industry standards, accountability, acceptability.	
Resources- Student Portfolio of work, Competency Skills Checklist.	

10th Grade Curriculum

Priority Standard 10.1 - Shop Safety	
Big Idea(s): <ul style="list-style-type: none"> ● Safety is a shared responsibility that protects everyone in the shop. ● Compliance with OSHA standards creates safe, productive workplaces. 	
Essential Question(s): <ul style="list-style-type: none"> ● Why is safety everyone's responsibility in a shop or industrial setting? ● Why are OSHA standards necessary for maintaining a safe and productive work environment? ● In what ways does maintaining a clean and organized workplace contribute to safety and professionalism? 	
Learning Outcomes	
<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
10.1.1 Safe Work Habits	<ul style="list-style-type: none"> ● Identify Personal Protective Equipment <ul style="list-style-type: none"> ○ Safety glasses ○ Foot ware ○ Clothing ● Demonstrate appropriate PPE use ● Follow shop safety rules ● Maintain a clean work area ● Score of 100% on a written safety test(VOG-Critical Thinker)
10.1.2 Electrical Safety	<ul style="list-style-type: none"> ● Explain current (VOG-Critical Thinker) ● Explain voltage (VOG-Critical Thinker) ● Identify factors that determine the degree of damage when electrocuted. ● Explain ventricular fibrillation. (VOG-Critical Thinker) ● Explain First Aid procedures for electrical shock. (VOG-Critical Thinker) ● Score 100% on the written district safety test. (VOG-Critical Thinker) ● Compare & Contrast Circuit breakers & fuses. ● Identify Fuse types and ratings ● Identify Circuit breaker types

<p>10.1.3 General First Aid</p>	<ul style="list-style-type: none"> ● Describe procedures for dealing with various injuries. ● Locate Eyewash station. ● Locate Automated External Defibrillator (AED) ● Explain the dangers of bloodborne pathogens. ● Identify who to contact in case of a first aid/emergency situation. ● Score 100% on a written safety test.(VOG-Critical Thinker)
<p>10.1.4 OSHA 1910 General Industry 10 Hour</p>	<ul style="list-style-type: none"> ● Complete 10 Hours of OSHA 1910 General Industry Training(VOG-Critical Thinker)
<p>10.1.5 Ladder Safety</p>	<ul style="list-style-type: none"> ● Explain and demonstrate the safe use of ladders. <ul style="list-style-type: none"> ○ Articulated Ladder ○ Single ○ Extension ○ Mobile ● Identify components of ladder. ● Score 100% on a written safety test. (VOG-Critical Thinker)
<p>10.1.6 Tools & Equipment</p>	<ul style="list-style-type: none"> ● Explain why tool selection for specific tasks is crucial for safety and efficiency. (VOG-Effective Communicator) ● Identify storage options for tools to ensure safety and organization.
<p>10.1.7 Robotic Safety</p>	<ul style="list-style-type: none"> ● Explain robot work envelope. (VOG-Effective Communicator) ● Describe Payload limits. ● Describe guidelines, barriers, sensors, and overload protection for robotics safety. (VOG-Effective Communicator) ● Identify maximum, restricted, & operating spaces of robots.

- | | |
|--|---|
| | <ul style="list-style-type: none">● Compare and contrast physical barriers vs electronic sensor safety barriers. |
|--|---|

Technical Vocab- PPE, Dress Code, SDS, Fire Extinguisher. Bloodborne Pathogens, AED, Eye Wash Station, Emergency Shut-off, Current, Voltage, Resistance, Ventricular Fibrillation, , Ladder, Circuit Breaker, Fuse, Payload, Work Envelope, Barrier, Sensor,. OSHA, Walking Working Surfaces, Emergency Action Plans, Fire Protection, Hazard Communication, Materials Handling, Machine Guarding, Industrial Hygiene, Bloodborne Pathogens, Ergonomics.

Resources- District Safety Test, District Safety Quiz, laddersafetytraining.org. Industrial Robotics Fundamentals G-W, sample fuses & circuit breakers, Z-Space Robotic Safety Software.

<https://www.osha.gov/otm/section-4-safety-hazards/chapter-4>

OHSA 1910 General Industry Trainer OR online program such as CareerSafe, or equivalent,

Priority Standard 10.2 - Magnetism & Electromagnetic Devices

Big Idea(s):

- Electricity and magnetism are interconnected forces that power modern technology.
- Different types of motors are designed to meet different performance needs.

Essential Question(s):

- How are electricity and magnetism connected, and why is this relationship essential to technology?
- What determines whether a motor or transformer is the right choice for a specific application?
- How does understanding motor nameplates, wiring diagrams, and schematics support troubleshooting and correct installation?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

10.2.1 Electricity Basics

- Describe the components of a DC power supply.
 - Transformers
 - Rectifiers
 - Filters
 - Regulators.
- Demonstrate the use of Ohm's Law ($V = IR$), where V is voltage, I is current, and R is resistance.
- Describe and Identify series circuits. (VOG-Work Ready)
- Describe and Identify parallel circuits. (VOG-Work Ready).

10.2.2 Magnetism & Electromagnetic Induction (DC)

- Analyze the properties of magnet.
- Explain how an electromagnet is temporary vs. permanent. (VOG-Work Ready)

10.2.3 Power Transformers

- Theory of operation
- Power Formulas

- Identify types of power transformers
 - Schematic
 - Physical
- Demonstrate mutual induction and operation between two inductors/coils.
- Identify the key components of an RF transformer

	<ul style="list-style-type: none"> ○ Windings ○ Air core ○ Coupling mechanisms. ● Apply the use of Ohm's Law ($V = IR$), where V is voltage, I is current, and R is resistance.
<p>10.2.4 Specialized Motors</p> <ul style="list-style-type: none"> ● Servo ● Stepper ● VFD ● Capacitors/capacitance (DC) 	<ul style="list-style-type: none"> ● Construct, demonstrate, and troubleshoot a digital circuit controlled motors, utilizing test equipment and reporting observations and measurements in a technical report format. (VOG-Work Ready) ● Describe the following motor operations <ul style="list-style-type: none"> ○ Servo motor ○ Stepper motor ● Describe the use of an encoder in a motor ● Identify the usage and ratings of capacitors in various motors
<p>10.2.5 DC motor.</p> <ul style="list-style-type: none"> ● Bearing ● Commutator ● Brushes ● Armature 	<ul style="list-style-type: none"> ● Describe where DC motors are found ● Explain the information found on a motor nameplate ● Identify the types and parts of a DC motor.
<p>10.2.6 Single-phase motors</p> <ul style="list-style-type: none"> ● Conduction motors ● Induction motors ● Stator ● Rotor ● Bearings 	<ul style="list-style-type: none"> ● Describe where Single-phase motors are found and explain the information found on a motor nameplate ● Identify motor leads T wire for forward and reverse rotation. ● Identify motor leads T wire for high and low voltage connections ● Identify the parts of a single-phase motor. <ul style="list-style-type: none"> ○ Conduction motors ○ Induction motors ○ Stator ○ Rotor ○ Bearings ○ shaft <p>(VOG-Work Ready)</p>
<p>10.2.7 Motor bearings</p>	<ul style="list-style-type: none"> ● Identify types of motor bearings

	<ul style="list-style-type: none"> ○ Ball ○ Roller ○ Liner ○ Plain (Bushings) ○ Flexure ○ Ceramic Hybrid
<p>10.2.8 Three-phase induction motor</p>	<ul style="list-style-type: none"> ● Describe how a three phase induction motor functions ● Identify types of rotors <ul style="list-style-type: none"> ○ Squirrel Cage ○ Wound ● Identify Key features of a three phase motor versus single phase. <ul style="list-style-type: none"> ○ Power & Torque ○ Efficiency & Operation ○ Starting & Design ○ Applications ● Explain the operation and connection methods of a three-phase induction motor (VOG-Effective Communicator)
<p>10.2.9 General Electrical Wiring</p>	<ul style="list-style-type: none"> ● Identify and Explain different types of circuit breakers, such as: <ul style="list-style-type: none"> ○ Thermal ○ Magnetic ○ Electronic ● Identify and Explain the function of the components within a PLC control cabinet: <ul style="list-style-type: none"> ○ PLC ○ Input/output (I/O) modules ○ Power supplies ○ Relays ○ Terminal blocks. ● Describe the principles of a three-phase system. ● Compare and contrast single-phase and three-phase systems. ● Describe the Wye (Y) and Delta (Δ) configurations of three-phase systems, including their geometric arrangements and how they connect to the power source and loads.

Technical Vocab- Motor, Induction, capacitive start, capacitive run, power rating, forward/reverse, High/low voltage connection, Roller bearing, Ball bearing. Inner race, Outer race, servo motor, stepper motor, OHM's Law, circuit breaker.

Resources- Textbooks, ETCAI Challenges, computer schematic software, multimeters, power sources, trainers, motors (single phase, 3-phase, etc.), 3-phase power supply/drop, 120VAC; 208/240VAC; &/or 480VAC in shop, motor trainers/hardware.

Priority Standard 10.3 - Print Reading, Math & Computer Applications II

Big Idea(s):

- **Math is the language that explains how digital and robotic systems behave.**
- **Ladder schematics are a foundational language of industrial automation.**
- **AI enhances problem-solving but requires human oversight and critical thinking.**

Essential Question(s):

- **Why is it important to compare calculated values to measured values when troubleshooting or verifying circuit performance?**
- **What role does software, such as Dobot, spreadsheets, and word processing tools, play in programming, documenting, and operating automated equipment?**

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

10.3.1 Algebra

- **Number Systems**
 - **Binary**
 - **Decimal**
 - Hexadecimal
 - **Binary Coded Decimal (BCD)**
- **Order of Operations**
- **Linear Systems**
- **Equations of Motion**

- **Select and demonstrate use of the correct equations to solve and predict various Digital circuit analysis.**
- **Select and demonstrate use of the correct formula for converting various number systems in Digital circuit analysis.**
- **Demonstrate proficiency in predicting output signals within industry standards and verify using measuring instruments.**
- **Calculate within industry standards digital circuit analysis functions. (VOG-Work Ready)**
- **Calculate within industry standards advanced robotics & automation circuit analysis functions. (VOG-Work Ready)**
- **Compare and contrast calculated values to measured values and determine percent error.**
- **Create mathematical models of linear systems used in robotics**
 - **Linear actuators**
 - **Position control systems.**
- **Derive and explain the basic equations of motion (position, velocity,**

	<p>acceleration) & their impact on robotics(VOG-Effective Communicator)</p>
<p>10.3.2 Computer Applications II</p>	<ul style="list-style-type: none"> ● Demonstrate the ability to use standard software such as: <ul style="list-style-type: none"> ○ Word processor ○ Slide presentation ○ Spreadsheets <p>(VOG-Effective Communicator)</p> <ul style="list-style-type: none"> ● Identify and Explain the key features and functions of the Dobot software interface, including toolbars, menus, and control panels.
<p>10.3.3 Relay ladder schematics</p>	<ul style="list-style-type: none"> ● Explain and demonstrate relay ladder schematics and how to convert to ladder logic programs ● Explain the steps of creating, editing and testing simple PLC programs utilizing the Relay Logic Instructions supported by RSLogix or equivalent PLC software. (VOG-Work Ready)
<p>10.3.4 Artificial Intelligence (AI) applications</p>	<ul style="list-style-type: none"> ● Use AI to create a scaffold program that can then be modified & corrected to fit the users requirements ● Use AI to help program a robot decision tree ● Use AI image identification to assist with automation & robotics tasks
<p>Technical Vocab- Binary, Octal, Decimal, Hexadecimal, Binary Coded Decimal (BCD), Linear, Sinusoidal, Exponential, Ladder Logic, Directional Control Valve, Flow Control Valve, Hydraulic Circuit Diagram, Hydraulic Valve, Hydraulic Fluid, Valve Actuators, Directional Control Valve, Compressor.</p>	
<p>Resources- Textbooks, computer software, multimeters, oscilloscopes, trainers, DoBot computer software and robotic system.</p>	

Priority Standard 10.4 - Instrumentation/Metering II

Big Idea(s):

- Measurement is the foundation of understanding and controlling electrical and automation systems.
- Digital sensors transform physical conditions into usable control signals.

Essential Question(s):

- Why is it important to know when to use a digital multimeter versus an oscilloscope?
- Why do PNP and NPN signals types matter when designing or troubleshooting automation systems?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

10.4.1 Digital/Portable Oscilloscopes

- Scope Probes x1/x10
- Amplitude
- Time (Period)

- Identify basic functions of digital oscilloscopes
 - Signal Visualization
 - Capture & Storage
 - Measurement
 - Analysis
- Display a stable trace, measure the amplitude and time period of waveforms.
- Understand display screen and controls.
- Analyze a DC circuit Voltage vs Time.
- Explain the difference between voltage RMS, VP, and Hz.
- Compare and contrast the DMM and Oscilloscope to measure effective voltage (RMS), voltage peak and frequency of an AC sine wave. (VOG - An Effective Communicator)

10.4.2 Electrical Measurement

- Fluke DMM Certification

- Obtain an official certification from Fluke (or equivalent) to use Digital Multimeters, safely and correctly. (VOG - Work Ready)

<p>10.4.3 Digital Switch signaling:</p> <ul style="list-style-type: none"> ● 2-wire ● 3/4-wire PNP & NPN sensor/device inputs/outputs 	<ul style="list-style-type: none"> ● Convert a physical signal (i.e. pressure, temperature, position) into a digital or “on/off” signal that a controller can read (VOG - Problem Solver) ● Compare & contrast the differences & advantages of various signal types ● Identify & install PNP & NPN sensors in the correct electrical orientation
<p>10.4.4 Electrical & Control Panels</p> <ul style="list-style-type: none"> ● Control Panel <ul style="list-style-type: none"> ○ Power Supply ○ Controller/Remote IO/PLC ○ Cable Trays ○ DIN Rails ○ Terminal Blocks ● Basic Control Panel Design: <ul style="list-style-type: none"> ○ Safety (LOTO, disconnects, fuses) ○ Sizing ○ Ingress Protection code (IP##): <ul style="list-style-type: none"> ■ Selection & Design ○ Wire routing ○ Component Organization 	<ul style="list-style-type: none"> ● Identify the parts of a control panel based on physical appearance & from electrical/panel schematics ● Identify basic design techniques including safety, interpreting the IP code, component & wire organization
<p>Technical Vocab- Oscilloscope, Time Base, amplitude, period, time/div, cycle, volts/div, sweep, calibrate, trace, trigger, Cal Terminal, grounded input,</p>	
<p>Resources- Oscilloscopes, Oscilloscope Probes, Fluke website Certification, Online Equipment manuals and resources, Textbooks, computer software, demonstrations, multimeters, components, power sources, Trainers,</p>	

Priority Standard 10.5 - Sensors & End-of-Arm Tooling

Big Idea(s):

- Sensors allow robots and automated systems to perceive and respond to their environment.
- End-of-arm tooling depends on both movement and design.

Essential Question(s):

- How do sensors allow robots and automated systems to understand and respond to their environment?
- How do the movements and design of end effectors determine what a robot is capable of doing?

Students will know:

As evidenced by: (oral, written, or performance)

10.5.1 Sensors

- Resistive Transducers
- Capacitive Transducers
- Inductive Transducers
- Vision Sensors
- Sound Sensors
- Speed Sensors
- Limit Switches
- Pressure sensors

- Explain the function of various transducers in the operation of sensors for robotic applications.
- Identify the types of sensors used in an automated system.
- Describe how sensors are integrated into an automated system. (VOG - Work Ready & An Effective Communicator)

10.5.2 Movements & End Effectors

- Grippers
- Suction cups & other “no prehensile” tooling
- Tools
- Changeable End Effectors
- End Effector Design

- Discuss the types of movements an end effector can perform.(VOG - A Problem Solver)
- Describe the types of end effector grippers and end effector tools.
- Identify the benefits of changeable end effectors.
- List important factors and characteristics in the design of end effectors.

10.5.3 Magnetic Sensors

- Magnetic sensors:
 - Coded
 - Non-coded
- Relay

- Demonstrate the installation and use of magnetic sensors
- Describe how a relay operates
- Communicate how a relay works like a switch (VOG - Work Ready & An Effective Communicator)

<p>10.5.4 Proximity Sensors</p> <ul style="list-style-type: none"> ● Optical ● Tactile ● Inductive ● Capacitive 	<ul style="list-style-type: none"> ● Describe the usage of various proximity sensors <ul style="list-style-type: none"> ○ Inductive Usage Installation ○ Capacitive Usage Installation ○ Photo electric Usage Installation ○ Ultrasonic Usage Installation
<p>10.5.5 Photo/Light Sensors</p> <ul style="list-style-type: none"> ● Infrared ● Ultraviolet ● Fiber Optics ● Laser ● X-Rays 	<ul style="list-style-type: none"> ● Describe and demonstrate the Usage and Installation of various Photo sensors (VOG - Work Ready & An Effective Communicator) <ul style="list-style-type: none"> ○ Tru-beam ○ Retroreflective ○ Diffuse
<p>10.5.6 Temperature sensors</p> <ul style="list-style-type: none"> ● Thermistor ● Thermocouple ● RTD (Resistance Temperature Detectors) 	<ul style="list-style-type: none"> ● Describe and demonstrate the Usage and Installation of various Temperature sensors (VOG - Work Ready & An Effective Communicator)
<p>Technical Vocab- Photo Sensor, Proximity Sensor, Temperature Sensors, Pressure Sensors, Acoustical proximity sensor, capacitance, computer vision sensor, inductance, infrared sensor, laser, limit switch, magnetic field sensor, microswitch, optical proximity sensor, opto-electronic, photoconductive device, photoemissive device, photovoltaic device, proximity sensor, range sensor, resistive transducer, sound sensor, speed sensing, strain gauge, tactile sensor, Thermistor, thermocouple, thermoelectric sensor, touch-sensitive proximity sensor, transducer, ultraviolet sensor, X-rays. Automatic tool changer, collet gripper, cylindrical grip, electromechanical gripper, expandable gripper, gripper, hook movement, lateral grip, magnetic gripper, mechanical finger gripper, nonprehensile movement, oppositional grip, overload sensor, palmar grip, prehensile movement, spherical grip, spread movement, vacuum gripper.</p>	
<p>Resources- Textbooks, computer software, demonstrations, multimeters, sensors, components, power sources, trainers. PLC Software, Arduino/Parallax Hardware and software, Robotic Arm hardware and software, VEX hardware and software, FESTO conveyor, picker, and stacker hardware and software, demonstrations, or equivalent. DoBot, Drone, Z-Space virtual software.</p>	

Priority Standard 10.6 - Digital Circuits & Programmable Logic Controllers (PLC's) I

Big Idea(s):

- Digital logic is the foundation of all automated decision making.
- PLCs replace traditional relay systems by providing flexible, reliable, and programmable control.
- Troubleshooting is a structured, logical process that ensures system reliability.

Essential Question(s):

- How does digital logic form the basis of all automated decision making?
- How do PLCs improve automation compared to traditional relay based systems?
- How does ladder logic provide a universal method for communicating and designing control systems?

Learning Outcomes

<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
<p>10.6.1 Digital Logic Gates</p> <ul style="list-style-type: none"> ● Inverter ● AND ● OR ● NAND ● XOR 	<ul style="list-style-type: none"> ● Explain and Demonstrate the operation of truth tables for the logic gates ● Demonstrate the operation and characteristics of a TTL logic gate.
<p>10.6.2 Programmable Logic Controller (PLC)</p> <ul style="list-style-type: none"> ● Processor ● Memory Devices ● I/O (Input/Output) ● Power Supply 	<ul style="list-style-type: none"> ● Describe what a PLC is and list advantages over relay systems. ● Explain the main parts of a Programmable Logic Controller (PLC) and explain their function. (VOG-Work Ready) ● Identify the three basic sections of a programmable logic controller ● List several applications of a programmable logic controller.(VOG-Work Ready) ● Explain the difference between a sinking and sourcing input module
<p>10.6.3 Relay ladder schematics</p>	<ul style="list-style-type: none"> ● Explain and demonstrate relay ladder schematics and how to convert them to ladder logic programs

	<ul style="list-style-type: none"> • Explain the steps of creating, editing and testing simple PLC programs using Ladder Logic supported by RSLogix or equivalent PLC software.
10.6.4 PLC ladder logic programs <ul style="list-style-type: none"> • Write • Enter • Run • Save • Online/Offline 	<ul style="list-style-type: none"> • Write, enter, run, and save ladder logic programs. (VOG-Work Ready) • Create a program using the computer software. • Understand the difference between online versus offline edits • Explain when & why to edit online versus offline (benefits versus disadvantages/risks) (VOG-Work Ready)
10.6.5 RSLogix, or equivalent, programming software	<ul style="list-style-type: none"> • Describe the features of RSLogix, or equivalent, software and the steps in using RSLogix, or equivalent, programming software.
10.6.6 PLC Simple input/output program.	<ul style="list-style-type: none"> • Write an input/output program
10.6.7 PLC relay function <ul style="list-style-type: none"> • Internal • External 	<ul style="list-style-type: none"> • Identify the function of internal and external relay instructions • Write a PLC program containing internal and external relay coils.
10.6.8 PLC Timers instruction	<ul style="list-style-type: none"> • Explain and describe how to convert PLC timers to ladder logic diagrams (VOG-Effective Communicator) <ul style="list-style-type: none"> • No retentive ON-delay • Retentive ON-delay • OFF-delay
10.6.9 PLC counter instructions.	<ul style="list-style-type: none"> • 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. (VOG-Work Ready) <ul style="list-style-type: none"> • Count up • Count down

	<ul style="list-style-type: none"> • Reset
10.6.10 PLC Combinations <ul style="list-style-type: none"> • Counter functions • Timer functions 	<ul style="list-style-type: none"> • Interpret combinations of counter and timer functions to create PLC ladder logic diagrams
10.6.11 PLC troubleshooting	<ul style="list-style-type: none"> • List and describe specific PLC troubleshooting procedures <ul style="list-style-type: none"> ○ Describe the problem ○ Eliminate Variables ○ Reproduce the problem ○ Attempt to fix
10.6.12 Variable frequency Drive	<ul style="list-style-type: none"> • List and describe various application of a variable frequency drive • Draw a wiring schematic of a variable frequency drive (VOG-Work Ready) • Create a simple program using a variable frequency drive.
<p>Technical Vocab- Inverter, AND Gate, NAND Gate, OR Gate, XOR Gate, IEC 61131-3, Ladder Diagrams, Function Block Diagrams, Structured Text, Sequential Function Charts, Ladder Logic, Rung, Coil, Relay, Timer, Contact, Sequential Control, Rectifier, Filter, Torque Control, Speed Control, Feedback, Dynamic Braking, Data Table, Subroutine, Variable, Communication Protocol, Fault Detection.</p>	
<p>Resources- Textbooks, computer software, multimeters, oscilloscopes, power sources, protoboard or equivalent. PLC Software, Arduino/Parallax Hardware and software, Robotic Arm hardware and software, VEX hardware and software, FESTO conveyor, picker, and stacker hardware and software. DoBot, Drone, Z-Space virtual software, various industrial sensors (Festo, SMC, Siemens, Omron, ABB, Emerson, Rockwell)</p>	

Priority Standard 10.7 - Robotics & Manufacturing Applications II

Big Idea(s):

- Robotics automation is the integration of multiple systems working together to improve efficiency, quality, and productivity.
- Complex machines transform motion and force to accomplish work efficiently.

Essential Question(s):

- How do automated systems integrate multiple machines, sensors, and controllers to improve efficiency, quality, and productivity?
- How do gear ratios, gear classifications, and mechanical advantage affect the speed, direction, and power of a mechanical system?
- How do microcontrollers like Arduino, Raspberry Pi, and Parallax bridge the gap between hardware and software in an automation system?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

10.7.1 Automation

- Tasks (problem solving)
- Multiple Process/Systems
- Interfacing/Communications
- Programming
- Troubleshooting/Testing
- Quality Control
- System Efficiency Improvements
- Career Pathways

- Simulate a manufacturing operation and automate using additional ancillary equipment beyond the robotic arms(VOG - Skilled Socially & Respectful)
- Completion of relevant modules in online, guided programming classroom (Code HS or similar)

10.7.2 Conveyor systems

- Belt
- Chain
- Mat
- Roller
- Pneumatic

- Construct advanced conveyor systems utilizing the DoBot system, or similar.
- Describe different types of chains (e.g., roller chains, silent chains) and their uses in mechanical systems.
- Explain pneumatic systems, including compressors, actuators, and valves used to control air pressure and motion.
- Explain the role of rollers in conveyor systems and other machinery for movement and support.

	<ul style="list-style-type: none"> ● Identify various types of conveyor mats or belts and their applications in material handling and automation. (VOG - A Critical Thinker)
<p>10.7.3 Complex Machines</p> <ul style="list-style-type: none"> ● Gears <ul style="list-style-type: none"> ○ Ring Gear ○ Beveled Gear ○ Sector Gear ○ Worm Gear ○ Planetary Gear ● Gear trains <ul style="list-style-type: none"> ○ Ring gear ○ Beveled gear ○ Sector gear ○ Worm gear ○ Planetary ● Chain and sprocket drive ● Stepped pulley and belt system ● Block and tackle system <ul style="list-style-type: none"> ○ Single Block ○ Double Block ○ Double ○ Gyn ○ Three-Fold Purchase ○ Force ○ Load ○ Movable & Stationary Blocks ● Cams <ul style="list-style-type: none"> ○ Plate ○ Grooved ○ Cylindrical or Barrel ● Linkages <ul style="list-style-type: none"> ○ Crank Rocker ○ Drag link ○ Double rocker ● Bearings ● Ball screws ● Clutches and brakes 	<ul style="list-style-type: none"> ● Identify various types of gears. ● Explain the differences of gears. ● Build a simple gear train to study how they affect power. ● Identify the three functions of gear trains. <ul style="list-style-type: none"> ○ Direction ○ Speed ○ Rotational Power ● Identify the four classification of gear trains. <ul style="list-style-type: none"> ○ Simple ○ Compound ○ Reverted ○ Planetary ● Explain and Apply gear ratios <ul style="list-style-type: none"> ○ Gear ratio= #of teeth input(driving) / # of teeth output (driven) (VOG - A Critical Thinker & An Effective Communicator) ● Explain the similarities and differences of a gear train. ● Demonstrate and explain the operation of Chain and Sprocket drive systems. (VOG - A Problem Solver & An Effective Communicator) ● Build a chain and sprocket drive 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.

	<ul style="list-style-type: none"> ● Identify components of a block and tackle system ● Explain the block and tackle systems ● Construct several different types of block and tackle systems and explain the function of each. ● Identify cams. ● Describe how a cam's shape causes linear motion (VOG- A Critical Thinker) ● Explain the function of the follower arm ● Graph the linear motion of a simple cam ● Label the parts of the linkage systems ● Build linkages.
<p>10.7.4 Advanced Robotic Microcontrollers</p> <ul style="list-style-type: none"> ● Hardware/Software <ul style="list-style-type: none"> ○ Arduino ○ Parallax ○ Raspberry Pi ● Interfacing/Translating between components & systems 	<ul style="list-style-type: none"> ● Write and upload code to a microcontroller to perform specific tasks or control external devices. (VOG- A Critical Thinker) ● Describe and identify various low voltage and network protocols and describe them in a report format to industry standards. ● Investigate by hands-on experience various interfacing/translating components and systems to proficiency from teacher created rubrics.
<p>Technical Vocab- Ring Gear, Beveled Gear, Sector Gear, Worm Gear, Planetary Gear, Chain and Sprocket, Pulley and Belt, Gyn, Three-Fold Purchase, Force, Load, Block, Tackle, Cams, Linkages, Bearings, Ball screws, Clutches, brakes.</p>	
<p>Resources- Online Equipment manuals and resources, Textbooks, computer software, test equipment, power sources, PLC Software, Arduino/Parallax Hardware and software, CodeHS Pro educational coding software, Robotic Arm hardware and software, VEX hardware and software, FESTO conveyor, picker, and stacker hardware and software, or equivalent. DoBot, Drone, Z-Space virtual software.</p>	

Priority Standard 10.8 - Assembly & Projects II

Big Idea(s):

- Clear, organized, and logical assembly processes ensure reliable and consistent results.
- A portfolio provides evidence of growth, competence, and readiness for future opportunities.

Essential Question(s):

- Why is it important for technicians to follow analytical, logical, and sequential processes when assembling projects?
- How does documenting evidence of learning through artifacts, written work, project rubrics, and proficiency scales support accountability and continuous improvement?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

10.8.1 Various Robot and Automation Projects covering the following Competencies:

- Safety
- Calculations
- Formulas
- Schematics
- Magnetism, & Electromagnetic Devices
- Advanced Robotics
- Sensors & End-of-Arm Tooling
- Oscilloscopes, Meters, and Measurement
- Digital Circuits and PLC's
- Troubleshooting and Repair
- Written Analysis with conclusion/discussion of results

- Obtain Proficiency determined by a scoring rubric. (VOG-Critical Thinker)
 - An 80% or greater on an individual project rubric would be considered proficiency in assembly.
 - Various: Written Analysis,, Shop Presentation, Research Project, Research from Industry Partners, Computer Aided Instruction Software, Field Trips, etc.
- Demonstrate industry standard behaviors expected for career employability. (VOG-Work Ready, Skilled Socially & Respectful)
- Demonstrate projects can be assembled to acceptable industry standards using analytical, logical, sequential, assembly norms. (VOG-Work Ready, Skilled Socially & Respectful)

10.8.2 Robotics & Automation Portfolio

- Upload evidence of proficiencies completing various projects to portfolio

	(VOG-Problem Solver)
Technical Vocab- Written Analysis, Conclusion, Discussion of Results, competency, portfolio, resume, artifacts, evidence, industry standards, accountability, acceptability.	
Resources- Student Portfolio of work, Competency Skills Checklist. PLC Software, Arduino/Parallax hardware/software, robotic arm hardware/software, VEX hardware/software, FESTO conveyor, picker, and stacker hardware/software, or equivalent. DoBot, Drone, Z-Space virtual software.	

11th Grade Curriculum

Priority Standard 11.1 - Shop Safety	
Big Idea(s): <ul style="list-style-type: none"> ● Safety is the responsibility of everyone in the shop ● Knowledge of safety prevents accidents and saves lives. 	
Essential Question(s): <ul style="list-style-type: none"> ● Why is safety everyone’s responsibility in a technical or manufacturing environment? ● In what ways do professionalism and work ethic contribute to a safe and efficient workplace? ● How do the safety habits we develop in school prepare us for success and responsibility in industry settings? 	
Learning Outcomes	
<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
11.1.1 Workplace Safety	<ul style="list-style-type: none"> ● Follow awareness strategies. ● Identify Workplace Safety Hazards. ● Explain Student Rights and Laws. (VOG-Respectful) ● Score 100% on a written safety test.(VOG-Critical Thinker)
11.1.2 Safe Work Habits	<ul style="list-style-type: none"> ● Identify Personal Protective Equipment (PPE). ● Demonstrate appropriate PPE use. ● Explain the importance of Professional Conduct / Work Ethic. ● Explain the importance of SDS (Safety Data Sheets) in the shop. ● Follow shop safety rules. (VOG - Work Ready) ● Maintain a clean work area/shop. (VOG - Work Ready) ● Locate Emergency shut-offs in shops.
11.1.3 General First Aid	<ul style="list-style-type: none"> ● Describe procedures for dealing with various injuries. ● Locate Eyewash station. ● Locate Automated External Defibrillator (AED)

	<ul style="list-style-type: none"> ● Explain the dangers of bloodborne pathogens. ● Identify who to contact in case of a first aid/emergency situation.(VOG - An Effective Communicator)
11.1.4 Electrical Safety	<ul style="list-style-type: none"> ● Explain the difference between current and voltage. ● Identify factors that determine the degree of damage when electrocuted. ● Describe ventricular fibrillation. ● Describe procedures for dealing with electrical shock. ● Obtain 100% on written safety quiz.(VOG-Critical Thinker) ● Compare & Contrast Circuit breakers & fuses. ● Identify Fuse types and ratings. Identify Circuit breaker types and ratings.
11.1.5 Ladder Safety	<ul style="list-style-type: none"> ● Explain the safe use of ladders ● Identify components of a ladder. ● Obtain a Step Ladder Safety credential.(VOG-Critical Thinker)
11.1.6 Tools & Equipment	<ul style="list-style-type: none"> ● Explain why using the correct tool for the task at hand is crucial for safety and efficiency. ● Identify different storage options for tools for both safety and organization.
11.1.7 Robotic Safety Considerations	<ul style="list-style-type: none"> ● Discuss safety practices related to tools and equipment. (VOG - Work Ready) ● Describe guidelines, barriers, sensors, and overload protection for robotics safety. ● Define maximum, restricted, & operating spaces of robots. ● Compare and contrast physical barriers with electronic sensor safety barriers ● Compare & contrast how safety considerations change with cobots.
<p>Technical Vocab- PPE, Dress Code, SDS, Fire Extinguisher. Bloodborne Pathogens, AED, Eye Wash Station, Emergency Shut-off, Current, Voltage, Resistance, Ventricular Fibrillation, , Ladder, Circuit</p>	

Breaker, Fuse, Payload, Work Envelope, Barrier, Sensor, cobot

Resources- District Mandated Safety Day curriculum and required documentation, District Safety Test, District Safety Quiz, laddersafetytraining.org. Chapter 3 of Industrial Robotics Fundamentals G-W, sample fuses & circuit breakers, Z-Space Robotic Safety Software, <https://www.osha.gov/otm/section-4-safety-hazards/chapter-4>

Priority Standard 11.2 - Math, Schematics, & Computer Applications III

- Big Idea(s):**
- Digital literacy is a cornerstone of modern industry.
 - Accuracy in documentation ensures reliability and safety.
 - Artificial intelligence (AI) is transforming how technicians approach automation.

- Essential Question(s):**
- How does technology allow technicians to solve complex problems more efficiently and accurately than manual methods?
 - How do accurate schematics ensure that systems operate safely and as designed?
 - How do software like MES & ERP platforms improve efficiency & productivity?

Learning Outcomes

<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
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|---|---|
| <p>11.2.1 Reading and Writing Schematic Diagrams</p> | <ul style="list-style-type: none"> • Define standard hydraulic & pneumatic symbols per ISO 1219. • Pass a schematic symbol identification test. • Construct electrical schematics according to IEC standards • Construct hydraulic & pneumatic systems from diagrams. • Construct diagrams of hydraulic & pneumatic systems per ISO 1219. • Create technical drawings that reflect written requirements or as-built conditions.(VOG - Problem Solver) |
|---|---|

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| <p>11.2.2 Computer Applications I</p> | <ul style="list-style-type: none"> • Create PivotTables on Excel • Use Conditional Formatting on Excel • Complete scenario analysis on Excel (logical formulas, i.e. “switch,” “case,” “goal seek,” etc.) • Import/export data to/from Excel • Create external data links in Excel • Use simple SQL queries including “select,” “update,” “join,” etc. • Filter SQL data. • Create database relationships in SQL. • Create and analyzing large datasets using data analytic software (VOG - |
|--|--|

	<p>Critical Thinker) (Excel, BI, SQL, etc.).</p> <ul style="list-style-type: none"> ● Create formal & professional reports/presentations using common professional software (PowerPoint, Word, PowerBI, MS Access, etc.).(VOG - Effective Communicator)
<p>11.2.3 AI as a Tool</p>	<ul style="list-style-type: none"> ● Use AI with a robot arm & camera to identify items & sort them. ● Use AI in quality assessment to reject defective parts while passing good parts based on an acceptable standard ● Use AI with MES & ERP software to quickly compile & analyze data.(VOG - Effective Communicator)
<p>Technical Vocab- Schematic, Pneumatics, Hydraulics, PivotTable, PivotChart, Formulas, Import/Export, SQL, SELECT, UPDATE, FROM, TO, UNION, databases, MES (“Manufacturing Execution Systems”) & ERP (“Enterprise Resource Planning”)</p>	
<p>Resources- Textbooks, computer schematic software, Microsoft Office Suite, SQL database software, AutoCAD, SolidWorks</p>	

Priority Standard 11.3 - Instrumentation/Metering III

Big Idea(s):

- Accurate measurement and control are the foundation of all automated systems.
- Calibration and maintenance are critical for precision and quality.
- Automation integrates physical measurement with digital logic.

Essential Question(s):

- How do sensors and transducers allow machines to “understand” and respond to physical changes in their environment?
- Why is accurate measurement and calibration essential to maintaining process quality and system reliability?
- In what ways does understanding pressure, temperature, and flow measurement help technicians design and troubleshoot control systems?

Learning Outcomes

<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
<p>11.3.1 Sensor Signalling</p>	<ul style="list-style-type: none"> • Convert a physical signal (i.e. pressure or temperature) to a digital or analog signal that a controller can read.(VOG - Problem Solver) • Compare/contrast the differences & advantages of various signal types. • Identify & install PNP & NPN sensors in a system. • Convert digital signals (i.e. I/P transducers for pressure-to-current & similar for temperature, light, etc.). • Compare /Contrast signal types (i.e. 4-20mA, 0-20mA, 1-5VDC, 0-5VDC, 1-10VDC, -5 to +5VDC, -10 to +10VDC).
<p>11.3.2 Pressure Transducers & Gauges</p>	<ul style="list-style-type: none"> • Read electronic & analog pressure gauges in a control system.(VOG - Work Ready) • Design a system using various pressure gauges based on the process conditions

	<p>provided (isolation, pigtails, orientation, connection methods).</p> <ul style="list-style-type: none"> • Describe calibration, drift, process limits, response rates, accuracy, resolution. • Identify a pressure switch versus sensor & describe when to use each.(VOG - Effective Communicator) • Troubleshoot common errors of pressurized systems.(VOG - Work Ready)
<p>11.3.3 Temperature Transducers & Gauges</p>	<ul style="list-style-type: none"> • Read electronic & analog temperature gauges in a control system.(VOG - Work Ready) • Compare temperature sensor types including thermocouples & RTD's. • Design a system using various temperature gauges based on the process conditions provided (isolation, pigtails, orientation, connection methods, thermowells). • Describe calibration, drift, process limits, response rates, accuracy, & resolution. • Identify a temp switch versus sensor & describe when to use each.(VOG - Effective Communicator) • Troubleshoot common errors of temperature controlled systems.(VOG - Effective Communicator)
<p>11.3.4 Flow Transducers & Gauges</p>	<ul style="list-style-type: none"> • Read electronic & analog flow gauges in a control system.(VOG - Work Ready) • Compare/contrast various common types of flow meters used in industry, include when & how each can or should be used (mass, magnetic, positive displacement [PD], ultrasonic, vortex, turbine, rotameter [analog]). • Design a system using various flow meter styles depending on the process conditions provided (isolation, orientation, connection methods, straight run pipe lengths, etc.).

	<ul style="list-style-type: none"> • Describe calibration, drift, process limits, response rates, accuracy, resolution. • Identify a flow switch versus sensor & describe when to use each.(VOG - Effective Communicator) • Troubleshoot common errors of flow control systems.(VOG - Effective Communicator)
<p>11.3.5 Electrical & Control Panels</p>	<ul style="list-style-type: none"> • Identify the parts of a control panel based on physical appearance & from electrical/panel schematics (Power Supply, Controller, Remote IO, PLC, Cable Tray, DIN Rails, Terminal Blocks). • Describe basic design techniques include safety, interpreting panel Ingress Protection (IP##), component & wire organization & sizing. • Construct a control panel based on panel & electrical schematics &/or a set of operational requirements.(VOG - Work Ready) • Construct a drawing package from scratch based on an existing control panel (“as-built” drawings).(VOG - Work Ready)
<p>11.3.6 Automated Metrology</p>	<ul style="list-style-type: none"> • Describe metrology & how it is an essential job in a high quality manufacturing environment. • Compare/contrast a CMM to a CNC Machine & describing how the 2 are commonly used together. • Perform manual CMM measurements. • Write a program to complete automated CMM measurements. • Compare /contrast different CMM probe types & how & when each should be used (touch, laser, 3D scan, etc.). • Perform standard calibration on a CMM
<p>11.3.7 PID Control Loops</p>	<ul style="list-style-type: none"> • Describe what each variable of a PID control loop does for a system (VOG -An

	<p>Effective Communicator) (proportional, integral, & derivative).</p> <ul style="list-style-type: none">● Describe how a control loop would be designed for a given set of process conditions/requirements.● Identify the Process Variable, Control Variable, & Set Point in a control loop.● Tune a control loop.
<p>Technical Vocab- I/P Transducer, PNP, NPN, Sinking, Sourcing, switch, sensor, digital, analog, CMM, metrology, PID, proportional, integral, derivative, Process Variable, Control Variable, Set Point, tuning</p>	
<p>Resources- Pressure Switches/Transmitters/Gauges, Temperature Switches/Transmitters/Gauges, various Flow Meters, piping/tubing; pumps; valves; & associated hardware, Digital Controllers/Programmable Logic Controllers, Online Equipment manuals and resources, Textbooks, computer software, demonstrations</p>	

Priority Standard 11.4 - Digital Circuits & Programmable Logic Controllers (PLC's) II

- Big Idea(s):**
- Digital logic is the foundation of all automated control systems.
 - Efficient programming is both a technical and creative process.
 - The future of manufacturing depends on interconnected, intelligent automation.

- Essential Question(s):**
- How do digital logic form the foundation for all automated control systems?
 - How can the structure and efficiency of a PLC program affect the performance of an automated system?
 - In what ways do Human Interfaces (HMIs) improve how people interact with automated systems?

Learning Outcomes

<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
<p>11.4.1 Digital Logic and PLC Fundamentals Review</p>	<ul style="list-style-type: none"> • Describe the use of logic gates in advanced automation systems. (VOG - An Effective Communicator) • Construct truth tables and logic expressions for compound conditions. • Translate Boolean logic into ladder logic equivalents. • Troubleshoot logic-based programming errors.
<p>11.4.2 Advanced Ladder Logic Programming</p>	<ul style="list-style-type: none"> • Construct multi-rung ladder logic programs with nested conditions • Implement advanced sequencing using latches and interlocks • Analyze program flow and optimizing logic for efficiency/ease of use • Edit, run, and debug ladder logic routines
<p>11.4.3 Human Machine Interfaces (HMI)</p>	<ul style="list-style-type: none"> • Describe the function of an HMI in automation systems.(VOG - An Effective Communicator) • Design and constructing HMI screens with input/output controls.

	<ul style="list-style-type: none"> ● Link PLC tags to HMI elements. ● Demonstrate real-time interaction between the HMI and PLC.(VOG- A Critical Thinker)
<p>11.4.4 PLC Communication and Networking</p>	<ul style="list-style-type: none"> ● Identify common industrial communication protocols (Ethernet/IP, Modbus). ● Describe how PLCs exchange data over a network. ● Configure basic network settings and IP addresses. ● Construct a simple PLC-to-PLC communication system.
<p>11.4.5 Sensors & Actuators in Automation</p>	<ul style="list-style-type: none"> ● Identify various sensors (proximity, photoelectric, pressure, temperature) ● Describe actuator function and application (motors, solenoids, valves).(VOG - An Effective Communicator) ● Wire sensors and actuators correctly in a control circuit. ● Construct programs integrate sensor input and actuator output.
<p>Technical Vocab- Boolean Expression, Truth Table, Logic Gate, Ladder Diagram, Combinational Logic, Latching, Interlocking, Sequencer, Nested Rung, Rung Condition, HMI Tag, Pushbutton Object, Real-Time Data, Indicator Lamp, Screen Navigation, Ethernet/IP, IP Address, Modbus, Node, Data Exchange, Proportional Gain (Kp), Integral Time (Ti), Derivative Time (Td), Setpoint, Process Variable, Proximity Sensor, Photoelectric Sensor, Solenoid, Actuator, Analog Signal, Structured Text (ST), Function Block (FB), IEC 61131-3, Code Syntax, Programming Paradigm, SCADA, Data Logging, Alarm System, Supervisory Control, Remote Monitoring</p>	
<p>Resources- Textbooks, computer software, multimeters, oscilloscopes, power sources, protoboard or equivalent. PLC Software, Arduino/Parallax Hardware and software, Robotic Arm hardware and software, VEX hardware and software, FESTO conveyor, picker, and stacker hardware and software. DoBot, Drone, Z-Space virtual software, various industrial sensors (Festo, SMC, Siemens, Omron, ABB, Emerson, Rockwell)</p>	

Priority Standard 11.5 - Pneumatic Systems & Devices in Automation

Big Idea(s):

- Compressed air is a powerful and controllable source of mechanical energy.
- Pneumatic systems depend on precise control of air flow and pressure.
- Pneumatic schematics are the blueprint for understanding and troubleshooting systems..

Essential Question(s):

- How does compressed air provide energy that can be controlled to perform mechanical work?
- Why must technicians understand how air pressure, volume, and flow interact to ensure a system operates safely and efficiently?
- Why is maintenance, calibration, and air treatment vital to the efficiency, safety, and lifespan of pneumatic equipment?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

11.5.1 Pneumatic Systems

- Describe the function and role of a pneumatic receiver in a pneumatic system, including how it stores and regulates compressed air. (VOG - Work Ready & An Effective Communicator)
- Identify key components of a pneumatic compressor, such as the motor, pump, pressure switch, and air tank, chiller/separator and dehumidifier.
- Identify the common symbols for pneumatic diagrams.
- Perform routine inspections and maintenance on air filters, checking for clogging or damage and replacing filters as needed.
- Describe the role of a pneumatic regulator in controlling the pressure of compressed air in a pneumatic system, ensuring it stays within desired range.(VOG - Work Ready & An Effective Communicator)

<p>11.5.2 Pneumatic Circuit Air Flow</p>	<ul style="list-style-type: none"> ● Describe the principles of air flow in pneumatic systems, including how pressure and volume are controlled and how they affect the operation. (VOG - Work Ready & An Effective Communicator) ● Use flow meters or other instruments to measure the flow rate of compressed air in a pneumatic system. ● Identify and explain the function of key components in a pneumatic system, such as compressors, actuators, pressure regulators, and valves. ● Describe the concept of pressure in pneumatic systems, including the relationship between force, area, and pressure.
<p>11.5.3 Pressure Regulators</p>	<ul style="list-style-type: none"> ● Demonstrate the use of a pressure regulator to control system air pressure. (VOG- A Critical Thinker) ● Identify key components of a pressure regulator, such as the diaphragm, spring, and adjustment mechanism(s). ● Describe the purpose and operation of a relief valve in a pneumatic system, including how it protects the system from overpressure.(VOG - Work Ready & An Effective Communicator) ● Describe what inlet pressure and outlet pressure are in a pneumatic system and their roles in the operation of pneumatic components.(VOG - Work Ready & An Effective Communicator) ● Compare/contrast how different regulators control upstream or downstream pressure & when each should be used.
<p>11.5.4 Flow Control Valves</p>	<ul style="list-style-type: none"> ● Explain the function of a flow control valve and its purpose. (VOG - Work Ready & An Effective Communicator)

	<ul style="list-style-type: none"> ● Install and operate a flow control valve in a simple pneumatic circuit. ● Describe the role of a throttle in pneumatic systems, including how they control flow and pressure of compressed air to regulate speed and force (i.e. flow rate and pressure). (VOG - Work Ready & An Effective Communicator) ● Recognize different types of restrictors, such as needle valves, orifice plates, and adjustable flow controls, and explain their applications.
<p>11.5.5 Flowmeters</p>	<ul style="list-style-type: none"> ● Describe the purpose and function of a flow meter. ● Compare/contrast different types of flowmeters ● Describe the components and operation of a flow meter, including how it measures the rate of airflow in a pneumatic system. (VOG - Work Ready & An Effective Communicator) ● Describe what calibration is and why it is important for ensuring the accuracy and reliability of pneumatic systems. (VOG - Work Ready & An Effective Communicator)
<p>11.5.6 Directional Control Valves (DCV)</p>	<ul style="list-style-type: none"> ● Explain the operation of the directional control valves (DCV).(VOG - A Critical Thinker & An Effective Communicator) ● 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.
<p>11.5.7 Pneumatic Cylinders</p>	<ul style="list-style-type: none"> ● Explain the function of single and double acting cylinders. (VOG - A

	<p>Critical Thinker & An Effective Communicator)</p> <ul style="list-style-type: none"> ● Install and operate a single and double acting cylinder in simple pneumatic circuits. ● Describe the role of a piston in a pneumatic system and how it converts compressed air into mechanical motion. (VOG -Work Ready & An Effective Communicator) ● Explain how the rod moves in response to pneumatic pressure changes and how it translates air pressure into mechanical motion.
<p>11.5.8 Pneumatic Circuit Lubricators</p>	<ul style="list-style-type: none"> ● Explain the function of a lubricator in a pneumatic circuit ● Install and operate a pneumatic lubricator. ● Describe the function and purpose of the reservoir within a pneumatic system. ● Explain how automatic lubrication is integrated into a pneumatic system to ensure smooth operation and reduce wear and tear on moving parts.(VOG - A Critical Thinker & An Effective Communicator)
<p>11.5.9 Pneumatic Air-treatment Systems</p>	<ul style="list-style-type: none"> ● Describe common components in a pneumatic air-treatment system. ● Install and operate an air filter in a pneumatic system. ● Describe the purpose of an air dryer in a pneumatic system, including how it removes moisture from compressed air to prevent damage and maintain system efficiency. (VOG - Work Ready & An Effective Communicator) ● Describe the role of a pressure switch in a pneumatic system, including how it monitors and controls air pressure. ● Explain how a pneumatic system separator works, including the

	<p>principles of separation (e.g., centrifugal force, filtration, or coalescence).</p>
<p>11.5.10 Venturi Vacuum Generators</p>	<ul style="list-style-type: none"> ● Describe the function of a venturi vacuum generator in a pneumatic circuit. ● Construct a simple pneumatic system with a Venturi tube to observe and measure changes in air pressure and velocity. (VOG- A Problem Solver) ● Describe how a vacuum generator works to create a vacuum and generate suction in a pneumatic system. ● Identify different types of diffusers used in pneumatic systems, such as those used for air distribution in automated machinery or ventilation systems. ● Describe the concept of vacuum levels in pneumatic systems and how they relate to pressure reduction and the performance of pneumatic components.(VOG - Work Ready & An Effective Communicator, & Skilled Socially)
<p>11.5.11 Electro-Pneumatic Systems</p>	<ul style="list-style-type: none"> ● Explain the use of electro-pneumatic systems. ● Locate and identify components of an Electro-Pneumatic system. ● Construct and test a pneumatic circuit using a DCV connected to a cylinder. ● Install and operate a two-cylinder sequencing circuit. ● Describe how pneumatic actuators convert compressed air into mechanical motion and how they are used to perform various tasks. ● Describe what a proportional valve is, how it operates, and its role in controlling the flow and pressure of air in a pneumatic system.

	<ul style="list-style-type: none"> ● Describe the function and operation of a flow control valve in a pneumatic system, including its key components and how it regulates the flow of compressed air. (VOG - A Critical Thinker & An Effective Communicator)
<p>11.5.12 Pneumatic Symbols</p>	<ul style="list-style-type: none"> ● Draw common symbols for valves and valve actuators. ● Identify common elements of a pneumatic cylinder. ● Create a simple pneumatic schematic. ● Recognize and interpret the symbols used to represent directional control valves in pneumatic circuit diagrams. ● Create accurate pneumatic schematics with standardized symbols.(VOG - Work Ready & An Effective Communicator)
<p>Technical Vocab- Pressure, Flow, Regulator, Check valve, Manual valve, Air piloted valve, Solenoid valve, Air preparation, Throttle, Restrictor, Needle valves, Orifice plates, Adjustable flow controls, Vacuum Generator Diffuser Vacuum Level, Air flow, Flow Rate, Piston, Rod, Automatic Lubrication.</p>	
<p>Resources- Textbooks, computer software, compressors, receivers, pneumatic valves (manual & automated), power sources, pressure regulators, rotameters, check valves, dryers, vacuum generators, pneumatic piping/tubing, pneumatic fittings (push-connect, threaded, etc.), actuators, pistons.</p>	

Priority Standard 11.6 - Hydraulic Systems & Devices in Automation

Big Idea(s):

- Hydraulics convert mechanical power into controlled motion through the science of fluid power.
- Valves are the brain of a hydraulic system.
- Hydraulic cylinders transform fluid power into useful mechanical motion.

Essential Question(s):

- How does hydraulic pressure allow a small input force to create powerful mechanical movement?
- In what ways do check, needle, and directional control valves affect how energy moves through a hydraulic circuit?
- How do hydraulic symbols and schematics serve as a universal language for designing and troubleshooting systems?

Learning Outcomes

<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
<p>11.6.1 Hydraulic Systems</p>	<ul style="list-style-type: none"> • Explain and identify the basic components of a hydraulic system pump (reservoir, system pressure gauge, pressure control valve, actuator, pressure safety valve). • Describe the basic principles of hydraulics, including Pascal's Law, which states that pressure applied to a confined fluid is transmitted equally in all directions.(VOG - An Effective Communicator, Skilled Socially, A Critical Thinker)
<p>11.6.2 Hydraulic Circuits</p>	<ul style="list-style-type: none"> • Describe fluid flow from the reservoir to the hydraulic circuit. • Identify and label the key components of a hydraulic system, such as pumps, cylinders, valves, hoses, and reservoirs. • Describe how hydraulic actuators use fluid pressure to produce mechanical motion.(VOG - An Effective Communicator)

<p>11.6.3 Fluid Power System</p>	<ul style="list-style-type: none"> ● Describe the various functions a hydraulic fluid performs in a fluid power system ● Describe how a DCV directs the flow of hydraulic fluid to control the movement of actuators, such as hydraulic cylinders or motors. ● Explain how hydraulic pumps convert mechanical energy into hydraulic energy, creating flow and pressure in the hydraulic system.(VOG - A Critical Thinker & An Effective Communicator)
<p>11.6.4 Hydraulic Fluid</p>	<ul style="list-style-type: none"> ● Identify common hydraulic fluid contaminants and explain the operation of a filter and strainer (dust, moisture, metal shavings, litter, carbon particles). ● Describe the role of additives in hydraulic fluids, such as improving viscosity, oxidation stability, and anti-wear properties.(VOG - Work Ready & An Effective Communicator) ● Explain what viscosity is, including its definition as a measure of a fluid's resistance to flow.
<p>11.6.5 Hydraulic Pumps</p>	<ul style="list-style-type: none"> ● Recognize different types of hydraulic pumps, such as gear pumps, vane pumps, piston pumps, and centrifugal pumps and explain their specific applications and advantages. ● Describe how hydraulic pumps work to convert mechanical energy into hydraulic energy by moving fluid through a system. (VOG - Work Ready & An Effective Communicator)
<p>11.6.6 Pressure Regulators / Pressure Relief Valves</p>	<ul style="list-style-type: none"> ● Explain the functions of pressure regulators and pressure in a hydraulic system relief valve.(VOG - A Critical Thinker & An Effective Communicator) ● Use a pressure regulator to control system fluid pressure.

	<ul style="list-style-type: none"> • Describe what hydraulic flow rate is, including its definition (volume of fluid passing through a given point per unit of time) and its importance in hydraulic systems. • Describe the difference and importance of pressure relief valves in addition to pressure regulating valves.
<p>11.6.7 Manual Directional Control Valves</p>	<ul style="list-style-type: none"> • Explain the function of a manual directional control valve in a hydraulic system.(VOG - A Critical Thinker & An Effective Communicator) • Construct and operate a manual directional control valve in a simple hydraulic circuit. • Describe what a hydraulic pressure rating is and its significance in hydraulic systems, including how it indicates the maximum pressure a component or system can safely handle. • Describe the function of each component in the hydraulic flow path and how they contribute to the overall system operation. (VOG - Work Ready & An Effective Communicator) • Describe how a hydraulic actuator works, including the principles of fluid mechanics and pressure that drive the actuator's movement.
<p>11.6.8 Check Valves</p>	<ul style="list-style-type: none"> • Describe how hydraulic check valves work, including their role in allowing flow in one direction while preventing backflow. • Demonstrate the operation of a check valve in a simple hydraulic circuit.(VOG- An Effective Communicator and A Problem Solver) • Identify the key components of a check valve, such as the valve body, poppet, and spring.

	<ul style="list-style-type: none"> • Describe the basic structure and components of ball check valves and poppet check valves, including the ball or poppet mechanism and the valve seat. (VOG - Work Ready & An Effective Communicator)
<p>11.6.9 Needle Valves</p>	<ul style="list-style-type: none"> • Explain how the needle valve controls the flow of hydraulic fluid by adjusting the needle's position relative to the seat, thereby regulating flow rate and pressure.(VOG - A Critical Thinker & An Effective Communicator) • Install and operate a needle valve in a simple hydraulic circuit. • Describe the main parts of a hydraulic needle valve, including the needle, seat, and adjustment mechanism.
<p>11.6.10 Hydraulic Cylinders</p>	<ul style="list-style-type: none"> • Describe how a hydraulic cylinder works, including the principles of hydraulic fluid pressure and force transmission. • Recognize and explain the main components of a hydraulic cylinder, such as the piston, cylinder barrel, rod, seals, and ports. • Install and operate a hydraulic cylinder in a simple hydraulic circuit. (VOG - Work Ready, Skilled Socially, & An Effective Communicator)
<p>11.6.11 Hydraulic Symbols</p> <ul style="list-style-type: none"> • Directional Control Valve • Flow Control Valve • Hydraulic Circuit Diagram • Hydraulic Valve • Hydraulic Fluid 	<ul style="list-style-type: none"> • Recognize and interpret common hydraulic valve symbols used in diagrams, such as directional control valves, pressure relief valves, and flow control valves. • Read and analyze hydraulic circuit diagrams that use these symbols to represent different valve functions and operations. (VOG - Work Ready & An Effective Communicator) • Describe the functions and operations of various types of hydraulic valves,

such as how they control the flow and direction of hydraulic fluid in a system. (VOG - Work Ready & An Effective Communicator)

Technical Vocab- Pressure, Flow, Regulator, Check valve, Manual directional control valve, Solenoid directional control valve, Fluid preparation, Piston, Cylinder Barrel, Rod, Seals, Ports, Flow Direction, Ball Check Valve, Poppet Check Valve, Valve Body, Poppet, Spring, Vane Pump, Piston Pump, Centrifugal Pump, Viscosity, System Pressure Gage, Pressure Control Valve, Pascal's Law

Resources- Textbooks, computer software, power sources, pressure regulators, rotameters, check valves, hydraulic piping/tubing, hydraulic fittings (threaded, etc.), actuators, pistons, hydraulic fluid + applicators, seals/gaskets, hydraulic presses.

Priority Standard 11.7 - Robotics & Manufacturing Applications III

Big Idea(s):

- Automation integrates mechanical, electrical, and digital systems to improve precision, productivity, and consistency in manufacturing.
- Technicians must balance innovation with responsibility.

Essential Question(s):

- How does automation improve efficiency, accuracy, and consistency in modern manufacturing?
- What are the benefits and potential risks of integrating AI into automated manufacturing systems?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

11.7.1 Automation

- Complete modules on robotic trainers (Amatrol, Festo, Dobot, etc.)
- Complete relevant modules in online, guided program classrooms (Code HS, FESTO LX or similar).
- Assemble VEX Robotics competition robots & completing in SkillsUSA Mobile Robotics
- Utilizing VEX Pneumatics on competition robots
- Use robot trainers & pneumatic/conveyor trainers to simulate various manufacturing processes.
- Integrate robotic arms into larger automated processes with other ancillary automated equipment.
- Participate in field trip to R&A Electronics Facilities (WBL or possible future WBL preferred) (VOG - Skilled Socially & Respectful)

11.7.2 Artificial Intelligence (AI) in Manufacturing

- Use AI to assist with writing code.
- Understand the limitations of AI to write code or answer technical questions and how to proofread &/or cross-check for accuracy.

- | | |
|--|---|
| | <ul style="list-style-type: none">● Use AI to solve complex manufacturing problems.● Use AI to assist with robot design/programming. |
|--|---|

Technical Vocab- VEX, Amatrol, Siemens, PLC, Pneumatics, FESTO, AI.

Resources- Online Equipment manuals and resources, Textbooks, computer software, test equipment, power sources, PLC Software, Arduino/Parallax Hardware and software, CodeHS Pro educational coding software, Robotic Arm hardware and software, VEX hardware and software, FESTO conveyor, picker, and stacker hardware and software, or equivalent. DoBot, Drone, Z-Space virtual software, Amatrol.

Priority Standard 11.8 - Assembly & Projects III

Big Idea(s):

- Real-world application of technical skills demonstrates mastery and readiness for industry.
- Professional behavior and employability skills are as important as technical expertise.
- Capstone projects represent the integration of knowledge, creativity, and technical skills.

Essential Question(s):

- How does completing real-world projects demonstrate mastery of robotics and automation skills?
- Why are precision, planning, and sequencing essential to producing high-quality assemblies?
- Why is accountability through measurable results and industry expectations essential for success in technical careers?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

11.8.1 Robotics and Automation Projects

- **Obtain Proficiency in required skills determined by scoring rubrics via:**
 - Written Analysis
 - Shop Presentations
 - Research Projects
 - Research from Industry Partners
 - Computer Aided Instruction Software
 - Field Trips
 - Etc.
- (VOG-Critical Thinker)**
- **Demonstrate industry standard behaviors expected for career employability.(VOG-Work Ready, Skilled Socially & Respectful)**
- **Demonstrate projects can be assembled to acceptable industry standards using analytical, logical, sequential, assembly norms.(VOG-Work Ready, Skilled Socially & Respectful)**
- **Demonstrate ability to program,**

	<p>maintain, & use various common robots, PLC's, meters, instruments, etc.(VOG-Work Ready, Skilled Socially & Respectful)</p> <ul style="list-style-type: none"> • Demonstrate a comprehensive understanding of safety in a manufacturing environment.(VOG-Work Ready & Skilled Socially)
<p>11.8.2 Robotics & Automation Portfolio</p>	<ul style="list-style-type: none"> • Complete line items on a Competency Skills Checklist.(VOG-Problem Solver) • Plan & prepare for Senior Capstone projects.(VOG-Problem Solver)
<p>Technical Vocab- Written Analysis, Conclusion, Discussion of Results, competency, portfolio, resume, artifacts, evidence, industry standards, accountability, acceptability.</p>	
<p>Resources- Student Portfolio of work, Competency Skills Checklist. PLC Software, Arduino/Parallax hardware/software, robotic arm hardware/software, VEX hardware/software, FESTO conveyor, picker, and stacker hardware/software, or equivalent. DoBot, Drone, Z-Space virtual software, Amatrol.</p>	

12th Grade Curriculum

Priority Standard 12.1 - Shop Safety

Big Idea(s):

- Safety is the responsibility of everyone in the shop
- Professional behavior and work habits are fundamental to safety and success.
- Following OSHA and industry safety standards build lifelong habits of responsibility and readiness.

Essential Question(s):

- Why is safety everyone's responsibility in a technical or manufacturing environment?
- How do organization, cleanliness and proper tool use contribute to safety and productivity?
- How do OSHA laws and safety standards prepare students for professional expectations in industry?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

12.1.1 Workplace Safety

- Follow awareness strategies.
- Identify Workplace Safety Hazards.
- Explain Student Rights and Laws.
- Obtain 100% on a written safety test.(VOG-Critical Thinker)

12.1.2 Safe Work Habits

- Identify Personal Protective Equipment (PPE).
- Demonstrate appropriate PPE use.
- Explain the importance of Professional Conduct / Work Ethic.
- Explain the importance of SDS (Safety Data Sheets) in the shop.
- Follow shop safety rules. (VOG-Critical Thinker)
- Maintain a clean work area/shop.(VOG-Critical Thinker)
- Locate Emergency shut-offs in shops.

12.1.3 General First Aid

- Describe procedures for dealing with various injuries.
- Locate Eyewash station.

	<ul style="list-style-type: none"> ● Locate Automated External Defibrillator (AED) ● Explain the dangers of bloodborne pathogens. ● Identify who to contact in case of a first aid/emergency situation.(VOG-Critical Thinker)
12.1.4 Electrical Safety	<ul style="list-style-type: none"> ● Explain the difference between current and voltage. ● Identify factors that determine the degree of damage when electrocuted. ● Describe ventricular fibrillation. ● Describe procedures for dealing with electrical shock. ● Compare & Contrast Circuit breakers & fuses. ● Identify Fuse types and ratings. Identify Circuit breaker types and ratings.
12.1.5 Ladder Safety	<ul style="list-style-type: none"> ● Explain the safe use of ladders. ● Identify components of a ladder.
12.1.6 Tools & Equipment	<ul style="list-style-type: none"> ● Explain why using the correct tool for the task at hand is crucial for safety and efficiency. ● Identify different storage options for tools for both safety and organization.
12.1.7 Robotic Safety Considerations	<ul style="list-style-type: none"> ● Discuss safety practices related to tools and equipment. (VOG-Effective Communicator) ● Describe guidelines, barriers, sensors, and overload protection for robotics safety. ● Identify maximum, restricted, & operating spaces of robots. ● Compare and contrast physical barriers with electronic sensor safety barriers ● Compare & contrast how safety considerations change with cobots.
<p>Technical Vocab- PPE, Dress Code, SDS, Fire Extinguisher. Bloodborne Pathogens, AED, Eye Wash Station, Emergency Shut-off, Current, Voltage, Resistance, Ventricular Fibrillation, , Ladder, Circuit Breaker, Fuse, Payload, Work Envelope, Barrier, Sensor,. OSHA, Walking Working Surfaces,</p>	

Emergency Action Plans, Fire Protection, Hazard Communication, Materials Handling, Machine Guarding, Industrial Hygiene, Bloodborne Pathogens, Ergonomics.

Resources- District Safety Test, District Safety Quiz, laddersafetytraining.org. Industrial Robotics Fundamentals G-W, sample fuses & circuit breakers, Z-Space Robotic Safety Software.

<https://www.osha.gov/otm/section-4-safety-hazards/chapter-4>

OHSA 1910 General Industry Trainer OR online program such as CareerSafe, or equivalent,

Priority Standard 12.2 - Math, Schematics, & Computer Applications IV

- Big Idea(s):**
- Technology enables professionals to solve complex problems through data driven decision making.
 - Artificial Intelligence is transforming how manufacturing problems are solved.

- Essential Question(s):**
- How can software aid a technician/engineering in complex tasks/problems?
 - Why is verifying model & software inputs & outputs an essential skill?
 - Why is being able to communicate findings & recommended actions essential?

Learning Outcomes

<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
<p>12.2.1 Computer Applications I</p>	<ul style="list-style-type: none"> • Describe how to solve complex problems and formulas using Excel tools such as Solver and Goal Seek to make data-driven decisions. (VOG - Critical Thinker) • Identify methods for creating dynamic Excel forms and templates that allow coworkers to input data accurately and efficiently. • Compare the features and uses of Word, PowerPoint, and related software to determine the most effective tools for presenting professional information. (VOG - Effective Communicator) • Explain how SQL and other database software can be used to structure, store, and manage large collections of data for analysis and reporting. • Demonstrate the ability to design, manage, and share digital documents, forms, and databases collaboratively in a professional team environment.

12.2.2 AI as a Tool

- **Demonstrate the use of AI to generate a preventative and predictive maintenance schedule based on bulk process data.**
- **Explain how AI can be applied in quality assessment to automatically create acceptable and reject part specifications based on example parts.**
- Determine ideal robot pathing with AI to optimize efficiency and workflow.
- Simulate factory operations and optimization scenarios using AI tools to evaluate performance and improvements.

Technical Vocab- PivotTable, PivotChart, Formulas, Import/Export, SQL; select; update; from/to; union; etc., databases, MES (“Manufacturing Execution Systems”) & ERP (“Enterprise Resource Planning”)

Resources- Textbooks, Microsoft Office Suite, SQL database software

Priority Standard 12.3 - Intro HMI's & SCADA Systems I

Big Idea(s):

- Human Machine Interfaces (HMIs) bridge the gap between people and automated systems.
- Innovation in interface and data systems defines Industry 4.0.

Essential Question(s):

- What purpose does an HMI (“Human/Machine Interface”) or SCADA (“Supervisory Control and Data Acquisition”) System provide in an Automation System?
- Why is it important to design HMIs that are both functional and user friendly?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

12.3.1 HMI's (“Human/Machine Interface”)

- Demonstrate programming an HMI using the manufacturing-provided software.
- Explain how to link variables from a control system to update and control the HMI in real time.
- Identify and apply various design principles, coordinating with cross-disciplinary teams to implement them as requested. (VOG - Effective Communicator)
- Describe how to physically locate and install HMIs on a factory floor, considering layout design principles and ease of access/monitoring.

**12.3.2 SCADA
(Supervisory Control and Data Acquisition)**

- Describe the structure and function of a SCADA system.
- Identify the differences between HMI and SCADA interfaces.
- Demonstrate how to construct basic SCADA screen elements.
- Explain how to use data logging and alarm capabilities within a SCADA system.(VOG - Effective Communicator)

Technical Vocab- HMI, SCADA, variable mapping,

Resources- HMI software & licenses, SCADA software & licenses, physical HMI's, SCADA display software, MES communication software, dedicated Ethernet LAN &/or equitable data communication network, high performance PC's & monitors, associated automation system(s) with sensor/device inputs & outputs (for control/monitoring)

Priority Standard 12.4 - Digital Circuits & Programmable Logic Controllers (PLC's) III

Big Idea(s):

- Advanced programming creates efficient, adaptable, and reliable automation systems.
- Sensors and signal processing are the foundation of intelligent automation.
- Cloud integration and data analytics empower proactive, informed decision making.

Essential Question(s):

- How do advanced programming techniques make automation systems more efficient, flexible, and reliable?
- In what ways do industrial networks and communication protocols impact system performance and troubleshooting?
- Why must technicians continually adapt to new programming tools and technologies in a rapidly evolving digital world?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

12.4.1 Advanced PLC Programming Techniques

- Demonstrate the ability to construct modular PLC programs using subroutines and interrupts.
- Describe the use of advanced data types such as arrays and structures. *(VOG - Effective Communicator)*
- Identify programming errors and implement appropriate error-handling strategies.
- Explain methods to optimize PLC code for efficiency and readability.

12.4.2 Structured Text (ST) and Function Block Diagrams (FBD)

- Describe the benefits of using IEC 61131-3 programming languages.
- Demonstrate writing control logic using Structured Text (ST).
- Construct control logic using Function Block Diagrams (FBD).
- Explain how to translate ladder logic into alternative programming formats.

12.4.3 Industrial Networking and Protocols

- Identify and describe common industrial network protocols such as PROFINET and EtherCAT.

	<ul style="list-style-type: none"> ● Demonstrate how to construct basic industrial network topologies using switches and routers. ● Explain methods to diagnose and troubleshoot network communication issues. ● Describe security fundamentals related to industrial networks. <i>(VOG - Critical Thinker & Effective Communicator)</i>
<p>12.4.4 Advanced HMI and SCADA Systems</p>	<ul style="list-style-type: none"> ● Demonstrate the ability to design multi-level HMI screens with dynamic components. ● Describe the role of data historians and trend analysis in SCADA systems. <i>(VOG - Effective Communicator)</i> ● Construct alarm management systems and explain event handling procedures. ● Demonstrate remote monitoring and mobile access capabilities within SCADA systems.
<p>12.4.5 Advanced Sensors and Signal Processing</p>	<ul style="list-style-type: none"> ● Identify smart sensors and IoT-enabled devices commonly used in automation. ● Describe signal filtering, conditioning, and analog-to-digital conversion processes. <i>(VOG - Effective Communicator)</i> ● Demonstrate the ability to calibrate sensors and analyze real-time sensor data. Explain how sensor inputs can be applied for predictive maintenance in industrial systems.

<p>12.4.6 Data Analytics and Cloud Integration</p>	<ul style="list-style-type: none"> ● Demonstrate the ability to set up cloud-based monitoring dashboards for real-time data visualization and analysis. ● Describe the basics of industrial data analytics and cybersecurity. ● Identify key elements of real-time data processing and remote access. ● Explain how cloud integration supports decision making in automation. (VOG - A Critical Thinker & An Effective Communicator)
<p>12.4.7 Troubleshooting Complex Automation Systems</p>	<ul style="list-style-type: none"> ● Demonstrate the ability to perform root cause analysis on complex automation faults to identify and resolve underlying issues. ● Identify system issues using diagnostic software and tools to troubleshoot automation systems effectively. ● Describe backup and system recovery strategies. ● Demonstrate systematic fault finding and repair techniques.
<p>12.4.8 Industry 4.0 and Emerging Technologies</p>	<ul style="list-style-type: none"> ● Describe key concepts of Industry 4.0, including cyber-physical systems and digital twins.(VOG - An Effective Communicator) ● Demonstrate the ability to research and present emerging automation technologies, highlighting their applications and potential impact. ● Identify applications of augmented reality and additive manufacturing in industry. ● Explain how smart factories integrate new technologies for efficiency. (VOG - A Critical Thinker & An Effective Communicator)
<p>Technical Vocab- Subroutine, Interrupt, Modular Design, Data Structure, Error Handling, PROFINET, EtherCAT, Router, Network Topology, Diagnostics, Data Historian, Alarm Management, Trend Analysis, Remote Monitoring, Screen Navigation, Smart Sensor, IoT Device, Signal Conditioning, ADC, Predictive</p>	

Maintenance, Data Dashboard, Cloud Computing, Cybersecurity, Real-Time Data, Remote Access, Root Cause Analysis, Diagnostic Software, Fault Code, Backup Strategy, Fault Finding, Cyber-Physical System, Digital Twin, Augmented Reality, Additive Manufacturing, Smart Factory

Resources- Textbooks, computer software, multimeters, oscilloscopes, power sources, protoboard or equivalent. PLC Software, Arduino/Parallax Hardware and software, Robotic Arm hardware and software, VEX hardware and software, FESTO conveyor, picker, and stacker hardware and software. DoBot, Drone, Z-Space virtual software, various industrial sensors (Festo, SMC, Siemens, Omron, ABB, Emerson, Rockwell)

Priority Standard 12.5 - Motor Controls

Big Idea(s):

- Motor Controllers are the foundation of modern automation.
- Different motors and control methods serve specific purposes.
- Motor control centers (MCCs) integrate power distribution and control.

Essential Question(s):

- How do motor control systems make automation possible in industry?
- How can different motor controllers provide different solutions & different levels of control on the same motor?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

12.5.1 Motor Controller Types

- Compare & contrast motor & starter/controller types
- Describe the benefits/draw backs of the different types of controllers/starters(VOG - An Effective Communicator)
- Identify different types of motors and motor control methods, including AC and DC systems, and explain their typical applications.

12.5.2 Motor System Installation

- Demonstrate the ability to select a compatible motor and drive combination based on specific process conditions.
- Demonstrate how to install a functional motor and drive system, including start-up procedures and troubleshooting.
- Describe the layout & purpose of a MCC for large-scale industrial automation. (VOG - An Effective Communicator)

12.5.3 Motor Programming

- Demonstrate the ability to program an existing motor and control system to perform according to specified process requirements.

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| | <ul style="list-style-type: none">• Identify and troubleshoot common motor errors to maintain reliable operation.• Demonstrate how to program and tune a motor to improve efficiency and performance. |
|--|--|

Technical Vocab- AC Motor, DC Motor, Brushed, Brushless, 3-phase, single-phase, motor starter, motor drive, variable frequency drive, pulse-width modulation, stepper, servo, motor control center, frequency, Hertz

Resources- Textbooks, computer software, multimeters, oscilloscopes, power sources, PLC Software, Arduino/Parallax Hardware and software, Robotic Arm hardware and software, motors, motor controllers, MCC buckets

Priority Standard 12.6 - Industrial Networking

Big Idea(s):

- Industrial networks are the backbone of automation and data exchange.
- Network architecture determines system reliability and performance.
- Troubleshooting and diagnostics are key to maintaining reliable network operations.

Essential Question(s):

- How do industrial networks ensure reliable communication between devices in automated systems?
- What are the key considerations for designing and securing industrial networks?
- In what ways do wireless technologies and network integration impact the future of industrial automation?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

12.6.1 Introduction to Industrial Networking

- Describe the purpose and importance of industrial networks in enabling reliable communication and control within automated systems.
- Identify different types of industrial networks and their typical applications.
- Explain how industrial networking supports automation and data flow. (VOG - A Critical Thinker & An Effective Communicator)

12.6.2 Network Protocols in Industry

- Identify key industrial network protocols, including Ethernet/IP, PROFINET, and Modbus TCP.
- Describe the basic functions of each protocol and their communication models.
- Compare the features and applications of common industrial network protocols to determine appropriate use cases.

12.6.3 Network Architecture and Topologies

- Construct network diagrams using different topologies like star, mesh, and bus.

	<ul style="list-style-type: none"> ● Identify network devices such as switches, routers, and gateways and their roles. ● Describe the advantages and disadvantages of common network topologies. (VOG - An Effective Communicator)
12.6.4 Network Configuration and Addressing	<ul style="list-style-type: none"> ● Demonstrate the ability to configure IP addresses and subnet masks on industrial network devices to ensure proper communication. ● Describe the difference between static and dynamic addressing (DHCP). (VOG - An Effective Communicator) ● Explain the basics of subnetting and its importance in network configuration.
12.6.5 Industrial Network Security	<ul style="list-style-type: none"> ● Identify common cybersecurity threats in industrial networks. ● Describe security measures, including firewalls and VPNs, used to protect industrial network systems. ● Explain best practices for securing industrial control systems. (VOG - A Critical Thinker & An Effective Communicator)
12.6.6 Network Troubleshooting and Diagnostics	<ul style="list-style-type: none"> ● Demonstrate the ability to use diagnostic tools, such as ping, traceroute, and protocol analyzers, to troubleshoot industrial network systems. ● Describe common network problems like latency, collisions, and packet loss. (VOG - An Effective Communicator) ● Demonstrate step-by-step troubleshooting procedures to isolate and resolve issues.
12.6.7 Wireless and Emerging Industrial Networks	<ul style="list-style-type: none"> ● Identify wireless networking technologies used in industrial settings (Wi-Fi, Bluetooth, Zigbee, 5G).

	<ul style="list-style-type: none"> ● Describe the benefits and challenges of wireless communication in industry. ● Explain the role of IIoT and its impact on industrial networking. (VOG - A Critical Thinker & An Effective Communicator)
<p>12.6.8 Network Integration with PLCs and SCADA Systems</p>	<ul style="list-style-type: none"> ● Describe how PLCs connect and communicate over industrial networks. ● Explain data exchange processes between PLCs, HMIs, and SCADA systems. (VOG - A Critical Thinker & An Effective Communicator) ● Identify network considerations critical for real-time control and monitoring.
<p>Technical Vocab- Industrial Network, Automation, Data Flow, Communication, Network Types, Ethernet/IP, PROFINET, Modbus TCP, DeviceNet, OSI Model, Switch, Router, Gateway, Star Topology, Mesh Topology, IP Address, Subnet Mask, DHCP, Static Addressing, Network Configuration, Firewall, VPN, Cybersecurity, Threats, Secure Communication, Latency, Packet Loss, Ping, Traceroute, Protocol Analyzer, Wi-Fi, Bluetooth, Zigbee, 5G, IIoT, PLC Communication, SCADA, HMI, Real-Time Control, Data Exchange</p>	
<p>Resources- Textbooks, computer software, multimeters, oscilloscopes, power sources, protoboard or equivalent. PLC Software, Arduino/Parallax Hardware and software, Robotic Arm hardware and software, VEX hardware and software, FESTO conveyor, picker, and stacker hardware and software. DoBot, Drone, Z-Space virtual software, various industrial sensors (Festo, SMC, Siemens, Omron, ABB, Emerson, Rockwell), PLC Academy (plcademy.com), Rockwell Automation's Literature Library, Siemens TIA Portal Demo, Cisco Networking Academy (free intro courses), Wireshark Protocol Analyzer, YouTube: RealPars & SolisPLC channels, AutomationDirect Learn, EtherNet/IP Developer's Guide, NIST Cybersecurity Framework, National Instruments Tutorials</p>	

Priority Standard 12.7 - Industrial Data Collection

Big Idea(s):

- Data drives decision making in manufacturing.
- Maintenance decisions based on real data improve reliability and reduce downtime.

Essential Question(s):

- How can a robotics technician utilize the data collected by a system
- How can AI be utilized to help a robotics & automation technician analyze large arrays of data in a timely manner?
- What defines “useful” data for a system?

Learning Outcomes

<i>Students will know:</i>	<i>As evidenced by: (oral, written, or performance)</i>
12.7.1 Types of Industrial Data	<ul style="list-style-type: none"> • Compare & contrast different types of data, how it might be useful, & to who • Analyze system performances based on production variables of a system (VOG - Critical Thinker) • Demonstrate the ability to create a maintenance schedule based on active condition monitoring. (VOG - Work Ready)
12.7.2 Visualizing & Analyzing Data	<ul style="list-style-type: none"> • Demonstrate the ability to create an HMI or SCADA layout for monitoring data. (VOG - Work Ready) • Demonstrate how to use various data historians to organize and analyze trend data. (VOG - Critical Thinker) • Explain how AI can be used to analyze large data sets and identify useful trends for decision-making.
12.7.3 Integration into Automation	<ul style="list-style-type: none"> • Demonstrate the ability to configure smart sensors to adjust inputs and outputs based on linked process or production data. (VOG - Work Ready) • Demonstrate how to implement PLC logic that makes real-time and relevant decisions based on active data collection.

Technical Vocab- Cycle Times, TAKT Times, Uptime, Downtime, Defects, OEE, absolute, relative, HMI, SCADA, Excel, Ignition, FactoryTalk, Amazon AWS, AI, Smart Sensors

Resources- Textbooks, computer software, multimeters, power sources, PLC Software, Robotic Arm hardware and software, FESTO conveyor, picker, and stacker hardware and software, various industrial sensors (Festo, SMC, Siemens, Omron, ABB, Emerson, Rockwell), Amazon AWS, IO-Link Sensors & Networking infrastructure

Priority Standard 12.8 - Robotics & Manufacturing Applications IV

Big Idea(s):

- All Modern Manufacturing is based on robotic processes that automate the production and delivery of goods and services.
- Collaboration between humans and robots defines modern manufacturing.

Essential Question(s):

- How does automation improve productivity, safety, and precision in modern manufacturing?
- How can complex machines aid with automating a production line or manufacturing facility?

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

12.8.1 Automation

- Demonstrate the ability to operate robotics and automation trainers across multiple processes.
- Participate in a field trip to a Robotics & Automation facility to observe real-world applications. (*VOG - Skilled Socially & Respectful*)
- Demonstrate how to simulate a manufacturing operation and automate processes using ancillary equipment beyond robotic arms.
- Complete relevant modules in online, guided programming classrooms, such as Code HS, Amatrol, or FESTO LX, to reinforce practical robotics and automation skills.

Technical Vocab- HMI, SCADA, AI, Motor Control, PLC's Industrial Networking, Industrial Data Collection

Resources- Online Equipment manuals and resources, Textbooks, computer software, test equipment, power sources, PLC Software, Arduino/Parallax Hardware and software, CodeHS Pro educational coding software, Robotic Arm hardware and software, VEX hardware and software, FESTO conveyor, picker, and stacker hardware and software, or equivalent. DoBot, Drone, Z-Space virtual software, Amatrol.

Priority Standard 12.9 - Robotics & Automation Assembly & Projects IV

Big Ideas

- **Mastery is demonstrated through the integration of knowledge, skills, and professional behavior.**
- **Problem solving is the foundation of process improvement.**

Essential Question(s):

- **Why is it important to apply industry standards in assembling and presenting robotics and automation projects?**
- **How can a portfolio of projects built to industry standards of quality and professionalism, assist in obtaining a job?**

Learning Outcomes

Students will know:

As evidenced by: (oral, written, or performance)

12.9.1 Robot and Automation Projects

- **Obtain Proficiency determined by a scoring rubric. (VOG-Critical Thinker)**
 - **An 80% or greater on an individual project rubric would be considered proficiency in assembly.**
 - **Various: Written Analysis,, Shop Presentation, Research Project, Research from Industry Partners, Computer Aided Instruction Software, Field Trips, etc.**
- **Demonstrate industry standard behaviors expected for career employability. (VOG-Work Ready & Skilled Socially and Respectful)**
- **Demonstrate projects can be assembled to acceptable industry standards using analytical, logical, sequential, assembly norms. (VOG-Work Ready & Skilled Socially)**

<p>12.9.2 Robotics & Automation Portfolio</p>	<ul style="list-style-type: none"> ● Demonstrate the ability to upload evidence of proficiencies by completing various projects to a professional portfolio. (VOG-Problem Solver) ● Demonstrate how to update and maintain the Competency Skills Checklist to reflect current abilities and achievements.
<p>12.9.3 Robotics & Automation Senior Summative Project</p>	<ul style="list-style-type: none"> ● Demonstrate the ability to apply knowledge and skills acquired throughout the four-year curriculum. ● Demonstrate how to produce a flowchart or block diagram reflecting the operation of a design. ● Demonstrate the ability to utilize various resources to support the design of a final system. ● Demonstrate how to produce a completed schematic diagram, flowchart, or equivalent of a robotic system suitable for prototyping, production, or manufacturing. ● Demonstrate the ability to construct a working prototype of a design to industry standards and teacher-created rubrics. ● Demonstrate the ability to present a finished project to a panel, incorporating Work-Based Learning experiences or on-the-job learning, following teacher-created rubrics.
<p>12.9.4 Senior Summative Assessment/industry standard certifications/credential Prep</p>	<ul style="list-style-type: none"> ● Score proficiency in the four year Robotics and Automation curriculum for Senior Summative Assessment Preparation(VOG-Critical Thinker, VOG-Work Ready)

12.9.5 Independent Study

- Demonstrate the ability to attend and actively participate in a job shadowing opportunity. **(VOG-Critical Thinker, VOG-Work Ready)**
- Demonstrate the ability to build an advanced senior summative project. **(VOG-Critical Thinker, VOG-Work Ready)**
- Demonstrate participation in SkillsUSA competitions and related activities.
- Demonstrate the ability to complete an additional industry or professional certification. **(VOG-Critical Thinker, VOG-Work Ready)**
- Demonstrate the ability to mentor classmates or underclass students under teacher guidance.
- Demonstrate the ability to obtain admission to colleges, secure grants, and earn scholarship opportunities.

Technical Vocab- Written Analysis, Conclusion, Discussion of Results, competency, portfolio, resume, artifacts, evidence, industry standards, accountability, acceptability.

Resources- Student Portfolio of work, Competency Skills Checklist. PLC Software, Arduino/Parallax hardware/software, robotic arm hardware/software, VEX hardware/software, FESTO conveyor, picker, and stacker hardware/software, or equivalent. DoBot, Drone, Z-Space virtual software, Student Portfolio of work, Competency Skills Checklist.