Utica City School District
Career and Technical Education Program
Advanced Manufacturing: Mechatronics and Robotics Pathway
Summary Overview

Pathway Overview

This pathway is designed to prepare students for careers, further education, and training in the robotics, automation, and mechatronics field. Students can prepare for a range of careers, including technicians who install, program, trouble-shoot, and repair equipment and engineers who plan, design, and build robotic and mechatronic systems. Before embarking on this pathway, students in 9th grade will complete an exploratory course from the CTE Elective Academies, where they will learn about various trades and careers and will have the opportunity to explore the skills and requirements of the different pathways available. In 10th, 11th, and 12th grades, students who choose to enter the Advanced Manufacturing: Mechatronics and Robotics Pathway will delve deeply into this focus area to develop fundamental knowledge and skills relevant to this field. In this pathway, students will explore the use of mechatronics and robotics in a wide variety of sectors, such as manufacturing, material handling and transport, healthcare and pharmaceuticals, agriculture and food production, earth and space exploration, and safety management. Through hands-on projects using a variety of robotic systems, such as VEX Robotics, FANUC Industrial Robotics, and Rockwell Automation (Allen-Bradley) Programmable Logic Controllers, students will act as robotics technicians and engineers, designing, analyzing, and building systems that automate processes used in real-world situations. Students will understand and apply their knowledge of robotic, mechanical, and electronic systems to analyze, manipulate, and debug mechanical assemblies, motors, and control systems. Students will learn the basics of programming and programming languages to interface with programmable logic controllers (PLC) and other programmable devices. Students will also develop their understanding of the engineering design process, print reading, and computer-aided design (CAD). Students will demonstrate strong skills in all aspects of workplace safety and the proper use of hand and power tools. Students will demonstrate clear and accurate communication skills, leadership and teamwork skills, and an awareness of issues around diversity, professional ethics, and environmental responsibility. Students will also be able to obtain such certifications as OSHA 10 Certification, ToolingU/SME Certified Manufacturing Associate (CMfgA), and FANUC Robotics Level 1 HandlingTool Operation and Programming Certification. Students will also have the opportunity to obtain other certifications, such as those offered through Rockwell Automation (Allen-Bradley) Programmable Logic Controllers, Autodesk Inventor, SOLIDWORKS CAD, and Python and C++ programming languages.languages.

Additional Learning Opportunities

- **Micro-credentials:** Students may pursue learning experiences and credentials depending on the requirements of the project that they are involved in. Some examples for this pathway include, but are not limited to:
    - OSHA 10 Certification
    - ToolingU/SME Certified Manufacturing Associate (CMfgA)
    - SMC Automation Training and Certification
    - FANUC Robotics Level 1 HandlingTool Operation and Programming
    - FANUC Robotics Level 2 Certification: 2D iRVision Operation and Programming
    - Rockwell Automation PLCs Level 1 Certification (Intro to Automation, AC/DC Drive, and Micro850)
    - Rockwell Automation Studio 5000 Logix Designer Level 1: Logix5000 System Fundamentals
    - Rockwell Automation Studio 5000 Logix Designer Level 2: Basic Ladder Logic Programming
    - Autodesk Inventor Certified User Certification (CAD)
    - Certified SOLIDWORKS Associate - Academic (CAD)
    - Programming Languages: Python and C++
    - Other relevant certifications as they become available through industry collaborations, teacher certifications, and student interest.
- **Summer Bridge Enrichment:** Students will have the opportunity to participate in cross-curricular Summer Bridge programs to enhance and enrich their skills. Students will explore and create solutions that address authentic needs in the school and wider community with the involvement of local industry professionals. Students will build on skills learned during the school year to work collaboratively with students from other pathways and programs.

Pathway Calendar

Level	Quarter	Project/ Driving Question	Units of Study
100 10th Grade	**1**	**What are the uses and impact of mechatronics and robotics in society?** **Project #1: TBD**	• Introduction to Robotics, Automation, and Manufacturing • Careers in Mechatronics and Robotics • Communication and Employability Skills • Workplace Safety o OSHA 10 Regulations • Work-Based Learning: Job Shadowing*

	2	**How do math and science provide the foundation for mechatronics and robotics?**
		
		Project #2: TBD
			• Math and Measurement Fundamentals: Computation, Formulas, and Metric Measurement
			• Physics Fundamentals:
			  o Mechanical Concepts: Energy and Simple Machines
			  o Electrical Concepts: Voltage, Current, and Resistance
			• Hardware Fundamentals:
			  o Components of Robotic Systems: Computers, Controllers, Sensors, Actuators, and Effectors
			  o VEX Robotic System Equipment
			• Work-Based Learning: Job Shadowing*

	3	**How can we program and control automated systems and robotics?**
		
		Project #3: TBD
			• Digital Electronic Fundamentals:
			  o Programming: Basic Programming Process
			  o Introduction to Programmable Logic Controllers (PLCs): Design and Function
			  o Programming VEX Robotic System Equipment
			• Work-Based Learning: Job Shadowing*

	4	**How does the engineering design process support revision and evolution of automated systems and robotics?**
		
		Project #4: TBD
			• Robotics and Automation Design:
			  o Engineering Design Process
			  o Specifications and Schematics
			  o Introduction to Computer-Aided Design (CAD)
			• Work-Based Learning: Job Shadowing*

200 11th Grade	**1**	**Why is ethics important in the field of robotics?** **Project #1: TBD**	• Career and Post-Secondary Education Research • Communication and Employability Skills: Ethics and Technology • Workplace Safety o OSHA 10 Regulations • Work-Based Learning: Job Shadowing*

	2	**Why does the design, and operation of a robot depend on its intended purpose?**
		
		Project #2: TBD
			• Math and Measurement Fundamentals: Basic Geometry and Trigonometry and Precision Metric Measurement
			• Physics Fundamentals
			  o Mechanical Concepts: Fluid Power Systems
			  o Electrical Concepts: Circuitry
			• Hardware Fundamentals:
			  o Components of Robotic Systems: Motors, Motor Control Systems, and Work Envelopes
			  o Programming VEX Robotic System Equipment: Host Computers and Teach Pendants
			• Work-Based Learning: Job Shadowing*

	3	**How do we determine the most efficient and effective way to control a robot or automated system?**
		
		Project #3: TBD
			• Digital Electronic Fundamentals:
			  o Programming: Programming Languages-Python and C++
			  o Programmable Logic Controllers (PLCs): Design and Function
			• Work-Based Learning: Job Shadowing*

	4	**How do we determine if a design is feasible?**
		
		Project #4: TBD
			• Robotics and Automation Design:
			  o Engineering Design Process
			  o Computer-Aided Design (CAD): 2D and 3D Design
			• Work-Based Learning: Job Shadowing*

Level	Quarter	Project/ Driving Question	Units of Study
300 11th Grade	**1**	**How can I control a robot or automated system in a safe and efficient way?** **Project #1: TBD**	● Career and Post-Secondary Education Research and Applications ● Communication and Employability Skills ● Workplace Safety o OSHA 10 Certification o Certified Manufacturing Associate (CMfgA) Certification ● Work-Based Learning: Job Shadowing*
	2		● Physics Fundamentals: Mechanical and Electrical Concepts ● Hardware Fundamentals: o Components of Robotic Systems: o FANUC Robotics Systems Operation: Power and System Controls ● Work-Based Learning: Job Shadowing*
	3	**How can we test and evaluate a design?** **Project #2: TBD**	● Digital Electronic Fundamentals o Programmable Logic Controllers (PLCs): Programming and Control o FANUC Robotics System Operation: Programming and Control ● Work-Based Learning: Job Shadowing*
	4		● Robotics and Automation Design o Engineering Design Process o Computer-Aided Design (CAD): Robotic System Design ● Work-Based Learning: Job Shadowing*
400 12th Grade	**1**	**How will I achieve my career goals?** **Project #1: TBD**	● Career and Post-Secondary Education Applications ● Communication and Employability Skills ● Workplace Safety o OSHA 10 Certification o Certified Manufacturing Associate (CMfgA) Certification ● Work-Based Learning: Job Shadowing
	2		● Physics Fundamentals o Mechanical Concepts: Application o Electrical Concepts: Application ● Hardware Fundamentals: o Components of Robotic Systems: Application o FANUC Robotics Systems Operation: Power and Systems Controls ● Work-Based Learning: Internship*
	3	**How are systems refined to ensure quality, efficiency, and manufacturability?** **Project #2: TBD**	● Digital Electronic Fundamentals o Programmable Logic Controllers (PLCs): Application o FANUC Robotics System Operation: Programming and Control o FANUC Robotics Level 1 HandlingTool Operation and Programming Certification o FANUC Robotics Level 2 Certification: 2D iRVision Operation and Programming ● Work-Based Learning: Job Shadowing*
	4		● Robotics and Automation Design o Engineering Design Process o Computer-Aided Design (CAD): Robotic System Design ● Work-Based Learning: Internship*

* Work-Based Learning: Job shadowing and internship experiences are ongoing throughout each quarter.