FIRST EDUCATION

Industry 4.0 & Robotics | Course Overview

Year-Long Course Outline with CTE Competencies

Equipment Requirements – XRP robot or *FIRST* Tech Challenge Control System, 3D Printer or other fabrication tools

Course Description

In this course, students will develop an industrial style robot and learn knowledge that aligns to the SME Robotics Fundamentals and Manufacturing Certification or AMTEC Emerging Technicians Certification. Students will design a robotic factory which moves products from one area to another. Groups in the class will utilize robots to automate the production process using manufacturing techniques and manufacturing style robots.

Course Outcomes

COMPETENCY	STUDENT OUTCOMES
Apply Engineering Design & Project Management Processes,	Students will define design criteria and constraints, develop project plans, assign team roles, and document design decisions and iterations using an engineering notebook.
Implement Industry 4.0 & Smart Factory Concepts	Students will apply Industry 4.0 principles by integrating data connectivity, sensors, and feedback systems into robotic manufacturing processes to improve monitoring and decision-making.
Identify & Apply Industrial Robot Safety Standards	Students will demonstrate safe robot operation by applying workspace safety rules, emergency stop procedures, and risk mitigation strategies during robot design and operation.
Analyze Industrial Robot Types & Applications	Students will evaluate collaborative, mobile, autonomous, and stationary robots and select appropriate robot types based on manufacturing task requirements.
Integrate Robot Mechanical & Electrical Systems	Students will identify robot components (joints, actuators, motors, encoders, end effectors) and assemble systems that meet defined payload, motion, and task requirements.
Select & Apply Sensors and Automation Components	Students will analyze and implement sensors, input/output devices, and material handling components (conveyors, feeders) to support automated manufacturing operations.
Apply Robot Programming & Control Systems	Students will develop and debug robot programs using coordinate systems, inputs/outputs, motion commands, arrays, and open- and closed-loop control logic.
Operate Robots within Manufacturing Workflows	Students will integrate robot programming into a simulated production environment and coordinate robot actions within a complete manufacturing process.
Apply Testing, Debugging & Iterative Improvement	Students will test robot performance, analyze operational data, and refine mechanical design and programming through iterative improvement cycles.
Implement Continuous Improvement Methodologies	Students will apply Kaizen and Plan-Do-Check-Act (PDCA) principles to identify inefficiencies and improve robotic manufacturing system performance.
Document & Communicate Technical Processes	Students will create technical documentation including design drawings, process flow diagrams, and operational procedures aligned to industry standards.
Demonstrate Readiness for Industry Certification	Students will apply robotics and manufacturing knowledge to practical scenarios and demonstrate proficiency aligned a robotics industry certification.

Industry Certifications

SME Robotics Fundamentals and Manufacturing Certification
AMTEC Emerging Technicians Certification
MSSC: Certified Production Technician (CPT) 4.0 (Covers Safety, Quality, Processes, and Maintenance)
SME: Certified Additive Manufacturing - Fundamental (CAM-F)
SME: Lean Bronze Certification (Foundational for Lean practitioners)

FIRST Training learning content that can be used to implement this course.

XRP Trainings	*FIRST* Robotics Competition	*FIRST* Tech Challenge Skill Builders
XRP Advanced Gears and Movement	Virtual Kit of Parts	Chassis and Drive Systems Lesson and Challenges
XRP Creating Movement	Module 2: How does *FIRST* Robotics Competitions Work?	Intakes Lesson and Challenges
XRP Engineering Design Process	Module 3: Intro to CAD and 3D Printing	Programming Lesson and Challenges
	Module 4: Fabrication Tools and Safety	
	Module 8: Design and Mechanical	

Standards Alignments

Organization	Aligned Standards
NGSS	HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-ETS1-4, HS-PS2-1, HS-PS3-3
ISTE	1.1.a, 1.1.c, 1.2.a, 1.4.a, 1.4.b, 1.5.a, 1.5.b, 1.6.a, 1.6.b, 1.7.b
ITEEA (STEL)	1M, 2P, 3L, 4J, 5I, 6F, 7K, 8K, 9L, 10M
NIMS	Measurement Materials & Safety (MMS), Industrial Technology Maintenance Awareness, Electrical Systems (Fundamentals), Quality & Continuous Improvement, CNC Operations (Intro), Manufacturing Processes, Workforce Readiness
NBEA	Information Technology II.A, Information Technology III.A, Communication III.A, Management III.A, Career Development I.B
ACTE-CRP	CRP1, CRP2, CRP4, CRP5, CRP6, CRP7, CRP8, CRP9, CRP10, CRP11, CRP12