Arizona CTE

Automation and Robotics 48.0500.20 (2022/23)

EXAMINE THE IMPACT OF NEW TECHNOLOGIES ON AUTOMATION AND ROBOTICS AR1.0	**1.1** Describe the principles, processes, and practices of AI (artificial intelligence), ML (machine learning), and RPA (robotic process automation) AR1.1
	1.2 Discuss how the application of AI, MI, and RPA have changed existing business (i.e., enhanced efficiency, increased work performance, reduced human error, simplified interactions, speedier processes, improved customer experience, etc.) AR1.2
	1.3 Give examples of how AI, ML, and RPA are used in services, manufacturing, agriculture, and healthcare [i.e., social media, virtual/personal assistant (Alexa and Siri), financial fraud detection, self-driving cars, medical diagnosis and prediction. etc.] AR1.3
	1.4 Relate the Three Laws of Robotics (Asimov's Laws) to future technology applications AR1.4
	1.5 Discuss ethical challenges associated with AI, ML, and RPA (i.e., privacy, data inaccuracies, future loss of jobs, how machines affect human behavior and interaction, etc.) AR1.5
PERFORM ELECTRICAL AND ELECTRONIC TASKS AR2.0	**2.1** Measure and determine voltage, current, resistance, and power in AC and DC circuits (i.e., oscilloscope, volt/ohm, meter, etc.) AR2.1
	2.2 Troubleshoot voltage, current, and power in AC and DC circuits (i.e., fuse, continuity, etc.) AR2.2
	2.3 Identify and troubleshoot components and connections AR2.3
	2.4 Read electrical drawings (i.e., simple starter circuits, PLC output, etc.) AR2.4
	2.5 Explain the role of electronic device in automation and robotics (i.e., common problems, common scenarios, etc.) AR2.5
ANALYZE HYDRAULIC AND PNEUMATIC SYSTEMS AR3.0	**3.1** Describe the relevance of material properties to robotics (e.g., inertia, velocity, mass, density, and strength) AR3.1
	3.2 Examine the performance of hydraulic circuits AR3.2

	3.3 Examine the performance of pneumatic circuits AR3.3
	3.4 Troubleshoot hydraulic and pneumatic circuits (i.e., flow controls, valve functionality, pressure sensors, etc.) AR3.4
	3.5 Describe the fundamentals of vacuum technology AR3.5
ANALYZE PROGRAMMABLE LOGIC CONTROLLER (PLC) SYSTEMS AR4.0	**4.1** Explain PLC functionality (i.e., relate schematics to PLC inputs/outputs, program flow, etc.) AR4.1
	4.2 Interpret ladder logic and other commonly used industrial languages AR4.2
	4.3 Develop a flowchart that identifies and solves the automation problem AR4.3
	4.4 Upload/download a logic program into a PLC AR4.4
	4.5 Troubleshoot input/output modules (AC and DC) AR4.5
DESCRIBE THE OPERATION AND USE OF VARIOUS FORMS OR ELECTRICAL MOTORS AR5.0	**5.1** Explain the “safety by design” concept to ensure operator and workspace safety AR5.1
	5.2 Explain the operation and use of DC motors in automation controls AR5.2
	5.3 Explain the operation and use of stepper motors in automation scenarios AR5.3
	5.4 Explain the operation and primary use of AC motors in automation assemblies AR5.4
	5.5 Explain the operation, use, and advantages of brushless motors in automation and robotics AR5.5
	5.6 Describe how servos are used in automation and robotics (e.g., robot arms, legs, and steering) AR5.6
PERFORM MECHANICAL SYSTEMS LINKAGES TASKS AR6.0	**6.1** Explain gear reduction and install a belt or chain drive AR6.1
	6.2 Explain gear ratio and install a gear train AR6.2
	6.3 Compute mechanical advantage of a belt or chain drive AR6.3
	6.4 Compute mechanical advantage of a gear train AR6.4
PERFORM DRAFTING TASKS AR7.0	**7.1** Make freehand sketches (e.g., line weights, hidden lines, center lines, and dimensioning) AR7.1
	7.2 Make CAD representations from freehand sketches AR7.2
	7.3 Determine shapes and sizes of surfaces from alternative views (e.g., orthographic, projection view, first angle projection, and third angle

	projection) AR7.3
	7.4 Make CAD drawings using geometric construction techniques AR7.4
	7.5 Make dimensional CAD drawings (e.g., 2D and 3D) AR7.5
	7.6 Explain basic knowledge of geometric dimensioning and tolerancing AR7.6
	7.7 Interpret electrical drawings and architectural plans AR7.7
IDENTIFY INDUSTRIAL ROBOT TYPES AND THE TASKS THEY PERFORM AR8.0	**8.1** Identify robot types and degrees of freedom (i.e., SCARA, articulated, cartesian, delta, etc.) AR8.1
	8.2 Measure robotic performance against specified criteria AR8.2
	8.3 Interface a robot to real or simulated external equipment AR8.3
	8.4 Simulate a solution AR8.4
EXAMINE DATA COMMUNICATION METHODOLOGIES AR9.0	**9.1** Select data communication protocols and associated connectors AR9.1
	9.2 Identify tradeoffs among wired and wireless data communication protocols AR9.2
	9.3 Explain IOT (Internet of Things) and IIOT (Industrial Internet of Things) AR9.3
APPLY SENSOR SOLUTIONS AR10.0	**10.1** Select sensors for use in a feedback control loop AR10.1
	10.2 Construct and operate a system with a feedback control loop AR10.2
	10.3 Calibrate sensors AR10.3
	10.4 Gather and statistically analyze performance data on a control loop AR10.4
	10.5 Explain analog to digital and digital to analog converters AR10.5
DESCRIBE COMMON MANUFACTURING PROCESSES IN AUTOMATION AR11.0	**11.1** Describe machining processes (i.e., traditional machining, CNC, etc.) AR11.1
	11.2 Describe basic material properties used in manufacturing processes (i.e., aluminum, steel, titanium, etc.) AR11.2
	11.3 Explain the impact of 3D printing on rapid prototyping AR11.3
	11.4 Explain additive manufacturing versus subtractive manufacturing AR11.4
	11.5 Describe basic fabrication principles (i.e., laser, sheet metal, welding, cutting, etc.) AR11.5

	11.6	Describe material handling [i.e., conveyers, bowl feeders, AGV (Automated Guided Vehicle), etc.] AR11.6
DEVELOP ROBOTICS APPLICATION SYSTEMS AR12.0	12.1	Describe robotics operating systems [i.e., ROS (robot operation system), Linux, etc.] AR12.1
	12.2	Identify a problem and develop a flowchart for software development (i.e., Boolean logic, ladder, etc.) AR12.2
	12.3	Identify peripheral hardware required to complete the task (i.e., vision systems, 3D scanners, end-of-arm tools, force sensing, etc.) AR12.3
	12.4	Develop or reuse software components (i.e., modular software design, etc.) AR12.4
	12.5	Use software tools to develop a robotics application AR12.5
	12.6	Use a simulation to develop and validate a design for a robotics problem AR12.6
	12.7	Use a test-driven development approach AR12.7
	12.8	Demonstrate a methodical approach to process development AR12.8
	12.9	Describe integration technologies (i.e., CNC, AI, RPA, ML, etc.) AR12.9
	12.10	Describe robotics project constraints (i.e., timeline, budget, environment, skill level, etc.) AR12.10
DEMONSTRATE SAFE AND PROPER USE OF ELECTRONIC AND OTHER LABORATORY EQUIPMENT, TOOLS, AND MATERIALS AR13.0	13.1	Explain and apply proper ground requirements AR13.1
	13.2	Specify safety conditions when working with automation and robotics (e.g., arc flash, high voltage, pneumatics, hydraulics, and stored energy) AR13.2
	13.3	Identify and properly use common electrical and electronics hand tools AR13.3
	13.4	Follow laboratory safety rules and procedures AR13.4
	13.5	Describe the concept of “fail safe” and how such components are integrated into robotic systems AR13.5
	13.6	Explain modern safety hardware and circuits (i.e., light curtains, safety fences, safety relays, etc.) AR13.6