Tennessee CTE

Robotics & Automated Systems

Safety	1	Accurately read and interpret safety rules, including but not limited to rules published by the National Science Teachers Association (NSTA), rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. 1
	2	Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. 2
Robotics Overview	3	Research the historical use of robotics from textbooks, news media, and other informational texts. Create a presentation concerning the various uses of robotics. For example, explore areas such as the surgical field, space exploration, agriculture, and advanced manufacturing. 3
	4	Write a persuasive essay explaining why robots should be used in certain circumstances. Cite textual evidence to support claims (for example, assemble evidence from medical journals to support a claim that the use of robots has lowered costs and increased efficiency among medical providers). Other examples may derive from the areas identified in standard 3. During a class discussion, defend original arguments and debate peer perspectives using claim(s) and counterclaim(s) developed in the persuasive essay. 4
Career Exploration	5	Create a presentation illustrating industries, organizations, and careers in Tennessee and other states that use robotics (such as Nissan in Automotive Manufacturing). Include work activities involved, postsecondary education needed, and skills necessary for these careers. (These could range from industry certifications to degrees in robotics engineering.) 5

	6 **Research the ethical considerations involved in developing new and modifying existing technologies. For example, investigate the National Society of Professional Engineers' (NSPE) Code of Ethics for Engineers or the Computer Ethics Institute's Ten Commandments of Computer Ethics. Select an existing technology and describe the ethical dilemmas faced by both producers and consumers of that technology, such as trade-offs between individual versus societal benefits or unforeseen consequences to the environment. For example, examine why some workers and labor unions may view robots as a threat to their jobs. Present findings to the class in a format appropriate for a career and technical student organization (CTSO) event.** 6
Programming	7 **Create a flowchart of a program for a robotic system. Convert the flowchart into a working program. Test, modify, and optimize the program. Write a technical report evaluating the performance of the program. Support all claims with specific examples.** 7
	8 **Log, store, and export data received from two or more sensors (for example, vision/light, audio, and touch) in a robotic or automated system. Explain why these procedures would be useful and provide specific examples.** 8

Engineering Design and Science & Engineering Practices

9 **Compare and contrast the following engineering design process with the eight practices of science and engineering (Achieve, 2013). Based on observations, write a brief paper explaining how the engineering design process and the science and engineering practices overlap, and describe how they might be used in automated systems design. Present findings to the class and refine the paper based on feedback.** 9

1 Engineering Design Process 9.1

a Identify the problem 9.1.A

b Identify criteria and specify constraints 9.1.B

c Brainstorm possible solutions 9.1.C

d Research and generate ideas 9.1.D

e Explore alternative solutions 9.1.E

f Select an approach 9.1.F

g Write a design proposal 9.1.G

h Develop a model or prototype 9.1.H

i Test and evaluate 9.1.I

j Refine and improve 9.1.J

k Create or make a product 9.1.K

l Communicate results 9.1.L

2 Science and Engineering Practices 9.2

a Asking questions (for science) and defining problems (for engineering) 9.2.A

b Developing and using models 9.2.B

c Planning and carrying out investigations 9.2.C

d Analyzing and interpreting data 9.2.D

e Using mathematics and computational thinking 9.2.E

f Constructing explanations (for science) and designing solutions (for engineering) 9.2.F

g Engaging in argument from evidence 9.2.G

h Obtaining, evaluating, and communicating information 9.2.H

Computers and Electronics

10 **Create an explanatory presentation that describes the parts necessary to make a robot and distinguishes it from a computer and a non-robotic machine. Parts necessary to make a robot include: (1) having a microprocessor for a brain, (2) sensors for input and output, (3) controls, and (4) motors. The presentation should include an informative report that describes various types of sensors (for example, auditory, visual, heat, etc.) and a summary of how sensors provide input. It should also describe various types of output (for example, motors, mechanisms, speakers, light, etc.) and discuss how sensors provide output.** 10

	11 Design, develop, and test a program to control a robotic system and robotic subsystems. The program should be able to receive data from a robot's input devices, process the data, and create outputs based on the inputs received. Present the robotic system to the class and provide details on the methodology used to design and develop the program, justifying selections as appropriate. 11
	12 Utilize feedback loops in a robotic system. For example, create a demonstration scenario and program a robot that requires the following: start, stop, or change motion within a robotic or automated system based on sensor input, provided by two or more sensors (such as vision/light, audio, and touch). 12
Mechanics	**13** Use mechanical tools, such as motors, gears, and gear trains in the construction of a robotic or automated system. Identify where forces are acting upon various points on the system and document with simple diagrams. Use the concepts of force, torque, and mechanical advantage to calculate the force acting upon the points in the system. 13
	14 Develop a system to demonstrate force, torque, work, and power acting upon or being done by a robotic or automated system. Justify the design by creating mathematical models that show the calculations. 14
Testing, Maintenance, Documentation, and Quality Assurance	**15** Use appropriate instruments to measure and record electrical, light, and audio outputs of a robotic system. Compare measured data to acceptable norms for the system. Document whether the system is performing within accepted parameters and cite evidence to support the claims. Perform maintenance or follow recommended procedures to correct malfunctions or underperformance within the system. Write a justification for any maintenance that is performed, citing data obtained from test results. 15
	16 Create a service and maintenance report on a robotic or automated system. The report should include text explaining the maintenance and corrective measures conducted. It should also include text justifying whether the system is functioning properly or recommending additional measures to correct any issues within the system. Finally, it should include text recommending quality-assurance policies and procedures to assure continuing operation of the system within acceptable parameters and text describing corrective procedures to be used when the system is malfunctioning or operating below optimal performance. 16

Projects

17 Working in a team, design and create a robotic solution to a given problem. Incorporate the engineering design process, as well as science and engineering practices, to develop a solution that meets the criteria for entries in a regional, state, or national robotics competition. Maintain an engineering notebook to document the details of the project. Write a technical paper (see components of the report below) and develop a presentation describing the solution and development process for the team solution. The technical paper should include, but is not limited to: 17

a Background 17.A

b Problem definition 17.B

c Design constraints 17.C

d Methodology 17.D

e Data analysis (e.g., charts, graphs, calculations) 17.E

f Results/Problem solution (include engineering drawings) 17.F

g Conclusions and recommendations for future research 17.G