



## **Engineering II: Robotics - Designing, Building, and Operating**

**Course Information**

<b>Grade(s):</b>	9-12
<b>Discipline/Course:</b>	Technology Education
<b>Course Title:</b>	Engineering II: Robotics - Designing, Building and Operating
<b>Prerequisite(s):</b>	Engineering I: Engineered Problem-Solving Through Design
<b>Course Description:</b> <i>Program of Studies</i>	This is a project-based course introducing students to the fundamental concepts of robotics through the engineering design process. Students will learn about the different components of robots, including actuators, sensors, and controllers. They will also learn about the principles of kinematics, dynamics, and control. Students will apply what they learn to design, build, and program their own robots. Students will participate in a variety of challenges to build, create, and operate robots that perform specific tasks and solve problems.
<b>Course Essential Questions:</b>	<ul style="list-style-type: none"> <li>● What is a robot?</li> <li>● How do we design robots?</li> <li>● What are the different components of a robot and how do they work together?</li> <li>● What are the different types of robots and how are they used in various industries?</li> <li>● How can we apply engineering principles to solve robotics problems?</li> </ul>
<b>Course Enduring Understandings:</b>	<ul style="list-style-type: none"> <li>● The Engineering Design Process provides a template for the study of robotic systems.</li> <li>● Robots are complex systems and require an understanding of the hardware and control systems which make them useful to mankind.</li> <li>● Robots can be adapted to various environments as needed in order to be beneficial to mankind.</li> <li>● Robots are useful machines that benefit society in many ways.</li> </ul>
<b>Duration / Credit(s):</b>	One Semester / .5 credit(s)
<b>Course Materials/Resources:</b>	VEX or similar robot kits. Various electrical supplies

<b>FPS Course Academic Expectation(s):</b>	CC Creating and Constructing: CI Conveying Ideas:
<b>Year at a Glance (Units)</b>	Unit 1 - Introduction to Robotics (2 weeks) Unit 2 - Robotics Design (4-5 weeks) Unit 3 - Robotics Construction (5-7 weeks) Unit 4 - Robotics Programming (4 weeks) Unit 5 - Advanced Robotics (2-3 weeks)

<b>Unit Number and Title:</b>	Unit 1 - Introduction to Robotics
<b>Duration:</b>	2 weeks
<b>Resource(s):</b>	VEX or similar robot kits. Various electrical supplies
<b>Unit Overview:</b>	This unit will provide an overview of robotics and the Robotics Design System used in the course. Students will learn about the parts of a robot and what actually classifies as a robot.
<b>Learning Goals</b>	
<b>Standard(s):</b>	<u>Connecticut Technology Education:</u> ENG.01 Identify the roles, responsibilities and requirements of engineering. ENG.02 Use the design process to solve problems by creating and refining prototypes.
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>● What is a robot?</li> <li>● What are the different types of robots?</li> <li>● What are the benefits and limitations of using robots?</li> <li>● What are the ethical implications of using robots?</li> </ul>
<b>Enduring Understanding(s):</b>	<ul style="list-style-type: none"> <li>● The Engineering Design Process provides a template for the study of robotic systems.</li> <li>● Robots are complex systems and require an understanding of the hardware and control systems which make them useful to mankind.</li> <li>● Robots can be adapted to various environments as needed in order to be beneficial to mankind.</li> <li>● Robots are useful machines that benefit society in many ways.</li> </ul>
<b>Learning Goal(s):</b> <i>Students will be able to use their learning to:</i>	<p><b><u>Content:</u></b> (Students will know... ):</p> <ul style="list-style-type: none"> <li>● how robotics is used in various industries.</li> <li>● the ethical implications of using robots.</li> </ul> <p><b><u>Skills:</u></b> (Students will be able to... ):</p> <ul style="list-style-type: none"> <li>● Identify the parts of a robot.</li> <li>● Identify the purpose of a robot.</li> </ul>

- Discuss the different types of robot control systems.
- Define the terms "autonomous" and "teleoperated" robots.

<b>Unit Number and Title:</b>	Unit 2 - Robotics Design
<b>Duration:</b>	4-5 weeks
<b>Resource(s):</b>	VEX or similar robot kits. Various electrical supplies
<b>Unit Overview:</b>	This unit will focus on the design process for building robots. Students will apply the engineering design process to robotics. This unit will include a review of some of the concepts covered in Engineering I: Mechanical Engineering, Electrical Engineering & Structural Engineering.
<b>Learning Goals</b>	
<b>Standard(s):</b>	<u>Connecticut Technology Education:</u> ENG.11 Demonstrate the application of science and math principles to the mechanical engineering process. EKS.05 Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate). MAN.01 Employ engineering design process to achieve desired outcomes
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>● How can the engineering design process be used to design robots?</li> <li>● What are the different factors to consider when designing a robot?</li> <li>● What is a drivetrain?</li> <li>● What is a manipulator?</li> <li>● How is a force transferred from an input to an output?</li> <li>● How can we design robots to be adaptable to different environments and tasks?</li> </ul>
<b>Enduring Understanding(s):</b>	<ul style="list-style-type: none"> <li>● The Engineering Design Process provides a template for the study of robotic systems.</li> <li>● Robots are complex systems and require an understanding of the hardware and control systems which make them useful to mankind.</li> <li>● Robots can be adapted to various environments as needed in order to be beneficial to mankind</li> </ul>
<b>Learning Goal(s):</b> <i>Students will be able to use</i>	<b>Content:</b> (Students will know...)

*their learning to:*

- the engineering design process
- the mechanical, electrical, and software requirements of a robotic system.
- the science and math principles within robot design.

**Skills:** (Students will be able to...)

- consider the goals of a robot in the process of designing.
- identify and consider the different factors involved in designing robots, such as functionality, cost, safety, and ethics.
- use CAD software to design and simulate robot mechanisms.

<b>Unit Number and Title:</b>	Unit 3 - Robotics Construction
<b>Duration:</b>	5-7 weeks
<b>Resource(s):</b>	VEX or similar robot kits. Various electrical supplies
<b>Unit Overview:</b>	This unit will focus on the building of robots. Students will learn about different types of robot components and how to assemble them into functional robots.
<b>Learning Goals</b>	
<b>Standard(s):</b>	<u>Connecticut Technology Education:</u> ENG.04 Design using the appropriate materials in engineering by identifying, Comparing, selecting and testing. ENG.06 Use engineering equipment, laboratory materials and tools appropriately and safely. EKS.05 Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate). BC.05 Describe characteristics and determine appropriate applications for various building material selections.
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>● What materials and tools are needed to construct a robot?</li> <li>● How do we use engineering equipment, laboratory materials, and tools safely and appropriately?</li> <li>● What are the best practices for assembling and testing a robot?</li> </ul>
<b>Enduring Understanding(s):</b>	<ul style="list-style-type: none"> <li>● The Engineering Design Process provides a template for the study of robotic systems.</li> <li>● Robots are complex systems and require an understanding of the hardware and control systems which make them useful to mankind.</li> <li>● Robots can be adapted to various environments as needed in order to be beneficial to mankind.</li> <li>● Robots are useful machines that benefit society in many ways.</li> </ul>



**Learning Goal(s):**

*Students will be able to use their learning to:*

**Content:** (Students will know...)

- different types of robot components: Structure, motion, power, sensors, logic, control

**Skills:** (Students will be able to...)

- safely operate robots.
- identify physical parts that are used to build robots.
- install the physical and electrical components necessary to make a robot work.
- assemble a robot.
- troubleshoot and repair robots.

<b>Unit Number and Title:</b>	Unit 4 - Robotics Programming
<b>Duration:</b>	4 weeks
<b>Resource(s):</b>	VEX or similar robot kits. Various electrical supplies
<b>Unit Overview:</b>	This unit will focus on teaching students how to program robots using software. Students will learn about fundamental programming concepts such as loops, conditionals, and variables in order to enable robots to complete specific tasks.
<b>Learning Goals</b>	
<b>Standard(s):</b>	<u>Connecticut Technology Education:</u> ENG.07 Identify and demonstrate the use of various software programs used in the engineering field. ENG.08 Demonstrate the application of science and math principles to the electrical engineering process.
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>• How do we program robots to perform specific tasks?</li> <li>• What programming languages are commonly used in robotics?</li> <li>• How can we use sensors and actuators to control robot motion?</li> <li>• Why is the process of debugging code important?</li> </ul>
<b>Enduring Understanding(s):</b>	<ul style="list-style-type: none"> <li>• The Engineering Design Process provides a template for the study of robotic systems.</li> <li>• Robots are complex systems and require an understanding of the hardware and control systems which make them useful to mankind.</li> <li>• Robots can be adapted to various environments as needed in order to be beneficial to mankind.</li> <li>• Robots are useful machines that benefit society in many ways.</li> </ul>
<b>Learning Goal(s):</b> <i>Students will be able to use their learning to:</i>	<p><b>Content:</b> (Students will know...)</p> <ul style="list-style-type: none"> <li>• basic programming language: the basic tenet of “If this, then that”</li> </ul> <p><b>Skills:</b> (Students will be able to...)</p> <ul style="list-style-type: none"> <li>• write a simple program for a robot to perform a task.</li> </ul>

- program a robot to use information from sensors to control its physical output.
- debug and refine robot programs.

<b>Unit Number and Title:</b>	Unit 5 - Advanced Robotics
<b>Duration:</b>	2-3 weeks, If time allows
<b>Resource(s):</b>	VEX or similar robot kits. Various electrical supplies
<b>Unit Overview:</b>	This unit is optional and can be added if time permits. It will focus on advanced topics in robotics such as drones, artificial intelligence, machine learning, and computer vision.
<b>Learning Goals</b>	
<b>Standard(s):</b>	<u>Connecticut Technology Education:</u> ENG.04 Design using the appropriate materials in engineering by identifying, Comparing, selecting and testing. ENG.07 Identify and demonstrate the use of various software programs used in the engineering field. MAN.01 Employ engineering design process to achieve desired outcomes
<b>Essential Question(s):</b>	<ul style="list-style-type: none"> <li>• What are some of the latest advances in robotics technology?</li> <li>• How are these advances being used to develop new and innovative robots?</li> <li>• What are the challenges and opportunities for the future of robotics?</li> </ul>
<b>Enduring Understanding(s):</b>	<ul style="list-style-type: none"> <li>• The Engineering Design Process provides a template for the study of robotic systems.</li> <li>• Robots are complex systems and require an understanding of the hardware and control systems which make them useful to mankind.</li> <li>• Robots can be adapted to various environments as needed in order to be beneficial to mankind.</li> <li>• Robots are useful machines that benefit society in many ways.</li> </ul>
<b>Learning Goal(s):</b> <i>Students will be able to use their learning to:</i>	<u>Content:</u> (Students will know...) <ul style="list-style-type: none"> <li>• about drones and drone technology (such as Zip Line)</li> <li>• principles of flight and flight control</li> </ul> <u>Skills:</u> (Students will be able to...) <ul style="list-style-type: none"> <li>• identify uses for drones and other non-manned aircraft..</li> </ul>

- explain some of the key applications of AI and ML in robotics.
- identify uses of AI in robotics.