SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Electronics and Robotics II	**Length of Course:** Half Year
Grade Level(s): 10-12	**Periods Per Cycle:** 6
Units of Credit: .5	**Length of Period:** 40 Minutes
Classification: Elective	**Total Instructional Time:** 60 Hours

Course Description

This is the second class of two at the high school that is intended for students to utilize the Design Process for authentic learning experiences in Electronics and Robotics. This class will introduce robotics to students with a focus on autonomous robots. The students will explore the structure, drivetrain, and functionality of robots operated by student programming.

Instructional Strategies, Learning Practices, Activities, and Experiences

Build Upon and Develop Minimum Competency Skills (MICS) Develop Advanced Competency Skills Design and Self-Reflect for Action Steps	Independent Research Project Construction Posted Objectives and Agendas	Bell Ringers Design, Build, Practice, Assess Process Journal Logs Constructive Responses

Assessments

Journals Weekly Checkpoints Small Group Discussions	Independent Projects Group Projects Panels of Experts	Competition Judges Competition Results Interviews with Local Businesses and Organizations

Materials/Resources

Technology Procedures and Equipment Instructor Provided Rubrics	Daily, Weekly, and Monthly Student Created Objectives	Competition Guidelines Various Materials Determined by Student(s') Needs

Adopted: 5/20/19
Revised: 12/9/20, 5/22/23

Unit 1: Introduction to Design Process	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
In this unit, students will learn about the Design Process **Key Terminology:** • Define the Problem • Collect Information • Brainstorm and Analyze Ideas • Develop Solutions • Gather Feedback • Improve	The student will have the ability to use the Design Process and prior knowledge from Electronics and Robotics I to solve a problem within the given constraints. 1. Define the Problem a. You can't find a solution until you have a clear idea of what the problem is. 2. Collect Information a. Collect sketches, take photographs, and gather data to start giving you inspiration. 3. Brainstorm and Analyze Ideas a. Begin to sketch, make, and study so you can start to understand how all the data and information you've collected may impact your design. 4. Develop Solutions a. Take your preliminary ideas and form multiple small-scale design solutions. 5. Gather Feedback a. Present your ideas to as many people as possible: friends, teachers, professionals, and any others you trust to give insightful comments. 6. Improve a. Reflect on all of your feedback and decide if or to what extent it should be incorporated. It is often helpful to take solutions back through the Design Process to refine and clarify them. **Minimum Competency Skills:** The student will have the ability to convert between units (metric and standard). The student will have the ability to measure lengths with accuracy using metric and standard units. The student will have the ability to learn the hardware components of a basic computer system. The student will have the ability to learn to code by writing commands. The student will have the ability to use functions to program small useful task that can be repeated. **Next Generation Science Standards (NGSS):** HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Unit 2: Robotic Design

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
Students will learn about how the field of robotics operates and how both manually operated and autonomous robots operate. Key Terminology: • Robot • Robotics • Subsystem • Manipulators • Control system • Sensors • Central Processing Unit (CPU) • Drivetrain • Actuators • Servo • Ultrasonic Range Finder • Gyroscope • Light Sensor • Optical Encoders • Microcontroller • Autonomous	The students will be able to: • Provide examples of how automated robots are used today in industry, research and in education. • Explain what the different basic components of a robot are and how each part performs a function in a larger machine. • Build a robot with given design criteria that can react to and solve complex problems. • Learn about the role of robots in society and how they are used in many aspects of modern life. • Examine reactionary systems, systems that react to various inputs. **Minimum Competency Skills:** The student will have the ability to follow a set of plans to build a robotic chassis with a given set of components. The student will have the ability to follow a wiring diagram to correctly wire a robot for remote controlled operations. The student will have the ability to make design changes and modifications to a robot to complete a given task. The student will have the ability to program a robot to make multiple moves using coding. The student will have the ability to program a robot to make decisions based on sensor inputs. The student will have the ability to design and make an end effector with the CAD/CAM process that accomplished a given goal. The student will have the ability to program a robot to make decisions based on sensor multiple inputs. The student will have the ability to follow a wiring diagram to correctly wire a robot for autonomously controlled operations. **Next Generation Science Standards (NGSS):** HS-ETS1-1 - Analyze a major global or District challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Unit 3: Coding Robot Movements

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
Students will learn to write and test the code used for robot movement control. **Key Terminology:** • Degree of Freedom • Design Constraints • Prototype • Control System • Control Board • Sensors • Commands and Sequences • Debugging • Functions • Conditional Code • While Loops • Algorithms • Variables • Parameters	The students will: • Generate and send code to the robot to perform given movement tasks. • Write and use functions that allow movement of a robot. • Explain what the specific components that make up the robotic control system can do and how they are used to control the robot. • Compare and contrast code controlled and drive controlled features of the robot. • Design code controlling the movement of the robot. **Minimum Competency Skills:** The student will make design changes and modifications to a robot to complete a given task. The student will write code to allow a robot to make multiple desired movements. The student will understand how functions are used create simple repeatable movements. The student will test and debug the code until the desired movements are completed. **Next Generation Science Standards (NGSS):** HS-ETS1-1 - Analyze a major global or District challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Unit 4: Sensor Controlled Movements	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Students will learn to write and test the code used for sensor integration. **Key Terminology:** • Degree of Freedom • Design Constraints • Prototype • Control System • Control Board • Sensors • Commands • Debugging • Functions • Conditional Code • While Loops • Algorithms • Variables • Parameters • Arrays • Touch Events	The students will: • Generate and send code to the robot to react to sensor input. • Explain what the specific components that make up the robotic control system can do and how they are used to control the robot. • Design code allowing robots to react to sensor input. • Combine use of functions, loops, and conditional code to create movements based on sensor input. **Minimum Competency Skills:** The student will make design changes and modifications to a robot to complete a given task. The student will program a robot to complete different movements based on sensor input. The student will follow a wiring diagram to correctly wire a robot for autonomously controlled operations. The student will design and make an end effector with the CAD/CAM process that accomplish a given goal. The student will test and debug the code until the desired sensor integration is completed. **Next Generation Science Standards (NGSS):** HS-ETS1-1 - Analyze a major global or District challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Unit 5: Solving Problems Through Coding	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Students will learn to code complex tasks using movements and sensor input. **Key Terminology:** • Function • Loop • If / And / Or Statements • While • Nesting Functions • Degree of Freedom • Design Constraints • Prototype • Control System • Control Board • Sensors • Commands • Debugging • Functions • Conditional Code • While Loops • Algorithms • Variables • Parameters • Arrays	The students will: • Generate and send code to the robot to solve a complex problem. • Integrate sensor input information to control the robot movements. • Use functions conditional code and loops to make the program adaptable. **Minimum Competency Skills:** The student will make design changes and modifications to a robot to complete a given task. The student will program a robot to make decisions based on sensor multiple inputs. The student will use code to increase the robot's autonomy. The student will design and make an end effector with the CAD/CAM process that accomplished a given goal. **Next Generation Science Standards (NGSS):** HS-ETS1-1 - Analyze a major global or District challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Unit 6: Systems Integration	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Students will learn about the technique integration of systems into a cohesive finished product. Students will learn how integration is an integral part of the initial design process. **Key Terminology:** • System Integration • Power • Control • Pneumatics • Drivetrain • Lifting Mechanisms • Object Manipulators	The students will be able to: • Demonstrate the use of six tips system integration for design and fabrication. • Design and build a project that uses more than one platform of the student's choosing to satisfy the constraints of the student identified issue. **Minimum Competency Skills:** The student will have the ability to follow a set of plans to build a robotic chassis with a given set of components. The student will have the ability to make design changes and modifications to a robot to complete a given task. The student will have the ability to program a robot to make decisions based on sensor multiple inputs. The student will have the ability to follow a wiring diagram to correctly wire a robot for autonomously controlled operations. The student will have the ability to use a remote control to correctly operate a robot through a given set of obstacles. The student will have the ability to program a robot to make decisions based on sensor inputs. The student will have the ability to design and make an end effector with the CAD/CAM process that accomplished a given goal. The student will have the ability to follow a wiring diagram to correctly wire a robot for remote controlled operations. **Next Generation Science Standards (NGSS):** HS-ETS1-1 - Analyze a major global or District challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.