Northern York County School District

Curriculum Overview

Course: Robotics Engineering	
Grade Level: 9-12	
Approval Date: March 2023	**Length of Time: 90 days / 0.5 credits**

Course Description:
Robotics Engineering leverages the "coolness" of robotics, and the excitement of head-to-head competition to inspire and engage students. Students use a design process and build a mobile robot capable of playing a sport-like game. Students learn key S.T.E.M. principles and robotics concepts. At the culmination of the course, students compete head-to-head against their peers in the classroom! This modular and project-based course teaches the design process in an engaging, hands-on manner to challenge, motivate, and inspire students.

Course Objectives:
- Students will utilize the engineering design process to methodically solve problems.
- Students will demonstrate knowledge of the basic components and subsystems of a robot.
- Students will use the VEXnet system to successfully control their robot in a classroom challenge.
- Students will explain how the process of strategic design works.
- Students will demonstrate the basic concepts of manipulators and accumulators.
- Students will demonstrate the concepts of speed, power, and torque.
- Students will understand and apply gear ratio (and the mechanical advantage) in a system.
- Students will compare the types of drivetrains, along with their benefits and drawbacks.
- Students will demonstrate system integration.
- Students will demonstrate a systematic process to prioritize the improvements dictated from the data collected from their testing.

Related Standards:

Pennsylvania Technology and Engineering Standards

Nature and Characteristics of Technology & Engineering:
- Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop.

Integration of Knowledge, Technologies, and Practices:
- Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system.

Applying, Maintaining, Assessing, and Evaluating Technological Products and Systems:
- Synthesize data and analyze trends to make decisions about technological products, systems, or processes.

Design Thinking in Technology and Engineering Education:

- Apply a broad range of design skills to a design thinking process.
- Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems.
- Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.

Units:
1. Introduction to Engineering and Robotics
2. Object Manipulation
3. Speed, Power, Torque, and DC Motors
4. Mechanical Power Transition
5. Drivetrain Design
6. Lifting Mechanisms
7. Systems Integration
8. Testing and Iteration Process

Concepts:
- Engineering design process
- Components and subsystems
- VEXnet programming software
- Strategic design process
- Manipulators and accumulators
- Speed, power, and torque
- Gear ratio and mechanical advantage
- Drivetrains
- System integration
- Design iteration

Competencies:
- Follow the engineering design process to solve real-world problems:
  Define the problem, generate concepts, develop solution, construct and test, evaluate solution, present and test solution.
- Design and build various robots/robotic systems using VEX robotics:
  Structure:
    - Hex Drive Screws
    - Specialty Screws
    - Spacers and Washers
    - Nuts and Standoffs
    - Gussets
    - Brackets
    - Couplers and Hinges
    - Aluminum Kit Components
    - Steel Kit Components
  Motion:
    - Omni-Directional Wheels
    - Traction Wheels
    - Specialty Wheels
    - Motors and Accessories
    - Standard Gears
    - High-Strength Gears
    - Advanced Gears
    - High-Strength Sprockets and Chains
    - Tank Tread Kit
    - Shafts and Hardware
    - High-Strength Shafts and Hardware
  Electronics:

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- o Joysticks, Controllers, and Accessories
- o Batteries and Chargers
- o VEX Electronics
- o Cables, Retention, and Miscellaneous

<u>Tools and Specialties</u>:
- o Hex Drivers
- o Hex and Star-Drive Keys
- o Open-Ended Wrench
- o Linear Motion Kit
- o Claw Kit
- o Pneumatics Kit 1
- o Pneumatics Kit 2

- Program robots using VEXnet software.
- Demonstrate knowledge of concepts: speed, power, torque, gear ratio, mechanical advantage, drivetrains, and system integration.
- Gather and analyze data for the purposes of design iteration.

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Learning Activities:	Performance Tasks:
- Individual and small group design/build projects - Individual and small group programming assignments - Head-to-head competition(s)	- Utilizing the engineering design process to solve real-world problems. - Constructing robotic assemblies using VEX V5 robots. - Using the VEXnet system to control robots during classroom challenges. - Using the data collected during competition/testing in different iterations of a robot's design.

Other Assessment Measures:
- Engineering notebook
- Online tests/quizzes

Textbook/Primary Resource:
- Autodesk VEX Robotics Curriculum (https://curriculum.vexrobotics.com/)

Supplemental Resource Materials:
- Teacher-generated instructional resources
- VEXcode V5 software
- Autodesk Inventor software