SCHOOL DISTRICT OF THE CHATHAMS

Honors Advanced Robotics
Grade 12
Full Year

Course Overview

This course will bring the FIRST Technology Challenge (FTC) to life inside the classroom. Students will design and build robotic devices that will compete at local and state competitions. The use of CADD software, computer programming, and construction materials will be used to help students explore various design options to create custom robots to complete a variety of tasks and obstacles. Students will participate during class time and designated hours outside of class to prepare to compete in highly competitive contests against other high school teams. Advanced Robotics Honors students will take a leadership role within the FTC team during competitions and outreach events. Additionally, they will help other student members become familiar with working in a collaborative environment, building techniques, and oversee completion of the FTC's engineering notebook.

New Jersey Student Learning Standards
The New Jersey Student Learning Standards (NJSLS) can be located at www.nj.gov/education/cccs/2020/.

Computing Systems
8.1.12.CS.1: Describe ways in which integrated systems hide underlying implementation details to simplify user experiences.
8.1.12.CS.2: Model interactions between application software, system software, and hardware.
8.1.12.CS.3: Compare the functions of application software, system software, and hardware.
8.1.12.CS.4: Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.

Engineering Design
8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ED.3: Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
8.2.12.ED.5: Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
8.2.12.ED.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).

Technology Standards
9.4.12.DC.6: Select information to post online that positively impacts personal image and future college and career opportunities.
9.3.12.ED.11 Demonstrate group management skills that enhance professional education and training practice.
9.3.12.ED-ADM.2 Identify behaviors necessary for developing and sustaining a positive learning culture.
9.3.IT-SUP.9 Employ technical writing and documentation skills in support of an information system.

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9.3.MN-HSE.1 Demonstrate the safe use of manufacturing equipment.
9.3.MN-PPD.3 Monitor, promote and maintain a safe and productive workplace using techniques and solutions that ensure safe production of products.
9.3.ST.1 Apply engineering skills in a project that requires project management, process control and quality assurance.
9.3.ST.3 Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.
9.3.ST-ET.1 Use STEM concepts and processes to solve problems involving design and/or production.
9.3.ST-ET.2 Display and communicate STEM information.
9.3.ST-ET.4 Apply the elements of the design process.
9.3.ST-ET.5 Apply the knowledge learned in STEM to solve problems.

Career Ready Practices

CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason
CRP6. Demonstrate creativity and innovation.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity

Interdisciplinary Connections

Health & Physical Education

- 2.1.12.SSH.4: Demonstrate strategies to prevent, manage, or resolve interpersonal conflicts without harming self or others.

Science

- 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.

Units of Study

Unit 1: Introduction to Robotics and Programming (~10 days)

- What is robotics?
- What is Java (programming language) and how is it useful in robotics and everyday life?
- Is programming precise?

Unit 2: Behaviors (~10 days)

- Why is it important to be able to do specific movements?
- How can sensors affect programming and movements for a robot?
- How do you break a problem into steps to accomplish the programming goal?

Unit 3: Technical Writing (~5 days)

- How can technical writing be utilized to successfully document a project?
- Why is it important for engineers to document their work in a specific way?
- Technical writing does not only consist of writing, what are other important ways information is conveyed in technical writing?

Unit 4: Decision Making (~10 days)

- How does “decision making” programming advance a robot's ability to make advanced decisions?

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- How do loops and switches advance a robot's ability to complete specific tasks?
- How do statements, variables, and constants improve your programming ability?

Unit 5: Mechanisms (~10 days)
- How can simple machines and complex machines be used to tackle obstacles?
- What are the differences between simple and complex machines?
- How can simple and complex machines be used to complete the assigned task?

Unit 6: FTC Competition (~ 145 days)
- What does it mean to represent your school with "Gracious Professionalism (large component of the FTC competition)?"
- How does the team compete and cooperate with alliances at tournaments?
- How does the FTC competition help develop strategic, problem solving, organizational, and team building skills?
- What can I do to assist first year students work efficiently in a group setting?
- What building techniques are important to demonstrate to first year students?
- What aspects of the FTC engineering notebook are important for first year students to understand?
- What does leadership mean in terms of leading the FTC team during competition and outreach?
- What are the components of a successful FTC engineering notebook?

Learning Objectives/Discipline Standards of Practice

Learning Objectives:
- Presentations on different forms of robotics that have an impact on our society
- Analyze the difference between telling someone to do something and breaking it into each individual step
- Create an "original program" to have someone complete a task
- Create "flow maps" to better break down large problems into smaller pieces
- Understand how to create continuous and controlled movement
- Manipulate and create machines to solve problems
- Create professional documentation adhering to the FTC Standards
- Utilize information regarding technical writing to create a professional design portfolio
- Utilize CADD software to create professional drawings to supplement their professional portfolio
- Understand what conditional execution is
- Understand the flow of a loop
- Create programs that can make decisions based on switches and condition statements
- Utilize variables and constants to create more complex programming
- Research and explore various components and brainstorm multiple solutions to the assigned design problem
- Collaborate and assist other teams in successful alliances during the competition setting
- Students will be able to define and present themselves with "Gracious Professionalism" in the competition atmosphere
- Create a comprehensive design portfolio detailing each step of the design process, problem solving, and team building strategies throughout the projects.
- Manipulate and create machines to solve problems
- Assist first year Advanced Robotics students work in a collaborative environment
- Demonstrate best practices in building technique for first year Advanced Robotics students

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- Illustrate the purpose of FTC's engineering notebook and demonstrate how to contribute to the notebook
- Demonstrate a leadership role in FTC competitions
- Demonstrate a leadership role in FTC outreach events
- Oversee successful completion of the FTC engineering notebook

Discipline Standards of Practice:

- Computing Systems
    - People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.
- Networks and the Internet
    - Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world.
- Impacts of Computing
    - Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and, in turn, computing influences new cultural practices.
- Data & Analysis
    - Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.
- Algorithms & Programming
    - An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.
- Engineering Design
    - People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet people's needs and desires, allows for the effective and efficient development of products and systems.
- Interaction of Technology and Humans
    - Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.
- Nature of Technology
    - Human population, patterns, and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate

variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution.

- Effects of Technology on the Natural World
    - Many of engineering and technology's impacts on society and the environment are widely regarded as desirable. However, other impacts are regarded as less desirable. Effects of Technology on the Natural World concerns the positive and negative ways that technologies affect the natural world.
- Ethics & Culture
    - Ethics and Culture concerns the profound effects that technologies have on people, how those effects can widen or narrow disparities, and the responsibility that people have for the societal consequences of their technological decisions.

Instructional Resources and Materials
Whole class resources have been identified with an asterisk.

Resources

- FTC Robotics Components
- FIRST Inspires (website)

Materials

- Engineering Notebooks
- Rev Robotics Components & Electronics
- Machines and Tools
- Prototyping Equipment
- Vinyl Cutter
- Soldering Irons

Assessment Strategies
Assessment is designed to measure a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes (formative assessment) and for evaluative purposes (summative assessment).

The following is a general list of the many forms assessment may take in learning.

- Class Discussion
- Teacher Observation
- Student Work Samples

Course Specific Assessments Include:

- Robotics & Programming:
    - Create a presentation highlighting different forms of robotics that have an impact on our society.
    - Create an "original program" to have someone complete a task.
- Behaviors
    - Create "flow maps" to better break down large problems into smaller pieces.
- Technical Writing
    - Create professional documentation/portfolio adhering to the FTC Standards.
        - Technical writing
        - Professional CADD drawings.

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- Decision Making & Mechanisms
    - Create a program that can make decisions based on switches and conditional statements.
    - Manipulate and create machines to solve problems.