DISTRICT
Course Description

(Must be accompanied by a Course Adoption form & Textbook Adoption Form)

Full Course Title: Robotics

School Associated with course: ☐ DHS ☐ ERHS ☑ PVHS ☐ SMHS

School Contact

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Department: Industrial Technology

Transcript Course Code(s) / Number(s):

Subject Area

- ☐ English Requirement
- ☐ World History
- ☐ US History
- ☐ Government
- ☐ Economics
- ☐ Mathematics
- ☐ Physical Science
- ☐ Life Science
- ☐ Physical Education
- ☐ Visual & Performing Arts
- ☐ Health
- ☑ Elective

Grade Level(s)

☑ 9 ☑ 10 ☑ 11 ☑ 12

Vocational Education (CTE) ☑ Yes ☐ No

Career Pathway: Engineering

Industrial Sector: Industrial & Technology

☑ **Introduction** ☐ **Concentration** ☐ **Capstone**

Unit Value

- ☐ Semester (5 units)
- ☑ Year A/B (5 units per semester)
- ☐ Year A/B (two period course, 10 units per semester)

Comments:

Course Purpose: *What is the purpose of this course?*

Students will work in pairs and quads as an engineering team. They will design, build and test increasingly complex robots that will be used in problem solving activities and competitions. The course will involve the engineering design process, the importance of integrating sensors, effectors and controls. Students will discuss robot learning and multi-robot systems. Robots will be used to solve bi-weekly challenges. The course culminates in a final project where student teams design, build, and program a robot for a final competition.

B. COURSE CONTENT

Course Outline: *A detailed descriptive summary of all topics covered. All historical knowledge is expected to be empirically based, give examples. (i.e. California State Standards).*

Unit 1 — Electricity

In this unit students will be introduced to electrical concepts. Students will start with an introduction to electric direct currents, voltages, resistors, and batteries. Students will learn and use the symbols to create basic circuit diagrams. This will be followed by an introduction to Ohms Law and its applications as related to series resistance, parallel resistance, and circuit analysis.

Upon completion of this unit;

-Students will understand electronic symbols (resistors, capacitors, diodes, switches, transformers, and batteries), the properties of parallel and series circuits. Students will master Ohms Law and calculating voltage and current through a parallel or series circuit.

-Students will be able to solder wires to resistors, batteries, switches, etc. After the completion of constructing a circuit, students will measure voltage and current through the circuit.

-Students will demonstrate mastery of the circuitry by completing a detailed 3 page report or electronic presentation on the circuit, calculations, and measurements done during the lesson.

-Students will required to begin (and continue throughout the course) a detailed journal of all their designs and activities. This will create a "tool box" from which the students can refer as the course progresses. Each design or activity will be accompanied by an in-depth reflection on what was successful and what needs to be improved, as well as schematics of any circuits created. Students will master the skill of scientific writing and data recording.

Signature Assignment:

Students will be required to use tools and best practices that are standard in the fields of electrical engineering and electronics engineering. Students will use their knowledge of electrical circuits to create a small flashlight out of a candy box or a similar project. The tools that they will use include, but are not limited to, digital multi-meters, soldering equipment, wire crimping and stripping tools. Students will learn how to strip wire insulation and attach solderless (crimping) connectors, tin wires, properly use flux and solder, among other things. Additionally, because this is the first unit, laboratory safety practices and procedures will be taught and practiced.

Unit 2 — Engineering Design Fundamentals

The engineering projects for this course will utilize tools, software, and conventions found in engineering fields. Students will be familiarized with basic tools, themes, and strategies regularly used in the fields of engineering. As this course progresses over the year students will draw from this "tool box" of skills as they encounter each new learning experience. Students will, in turn, master these tools, themes, and strategies by applying them when necessary rather than practicing them in abstraction.

Upon completion of this unit;

-Students will understand drafting and fundamental scaling. Students will master ratios, athematic, unit conversions and drawing.

-Students will master the use of tools (hand and power). "Shop" safety will also be taught and practiced.

-Students will work in teams to fabricate a catapult that will achieve specific objectives related to distance and accuracy.

-Students will add related entries and reflection to their journal related to their accomplishments and acquired knowledge/skills.

-Students will complete a detailed 3-5 page report or electronic presentation to tie in everything in this unit from drafting to fabrication and testing their design.

Signature Assignment:

Students will be introduced to sketching fundamentals and drafting conventions and standards, by working collaboratively to create a catapult. Students will learn how to create schematics and learn how to draw parts and assemblies. Students will begin the assignment with basic drafting tools and then progress toward current product development drawing tools (CAD software). Students will experience the steps of the design process including topics such as prototyping, model building, testing and manufacturing. Students will supplement their in-class learning with assigned internet research and completed learning logs or journal entries.

Unit 3 — Construction of VEX Robots

Students will begin to apply engineering principles, as outlined in the Next Generation Science Standards, to the design and construction of robots. Students will study the fundamental design of a Vex robot. While students are learning how to fabricate their first Vex robot, they will also be required to draw upon physics concepts such as speed, velocity and angular momentum. Further a significant amount of math is necessary to fabricate the complex geometries of the parts that are required for robots. Students will create a robotic platform capable of two-dimensional motion at a variety of speeds. This platform must also be capable of supporting a variety of sensors (unit 6) and electrical systems for remote access (unit 4). Through this project students will be introduced to the various fastening and joining methods typically used in production development. These include, but are not limited to, screws, bolts, nuts, rivets, and welding. Students will be introduced to specification sheets for materials used in engineering and also start to learn about concepts related to materials stress, strain, toughness, elasticity, thermal conductivity, etc.

Upon completion of this unit;

-Students will understand how different components (batteries, multi-controllers, motors, gears and wheels) interact with each other in unison.

-Students will master the construction of a functioning robot with hand tools.

-Students will master installing motors, bearings and making adjustments for motion.

-Students will understand how different gear rations and different sized wheels affect the movement of the robot.

-Students will add related entries and reflection to their journal related to their accomplishments and acquired knowledge/skills.

-Students will complete a detailed 3-5 page report or electronic presentation to tie in everything in this unit from design to fabrication and the related physics and mathematics of robots.

Signature Assignment:

Students will construct their first Vex robot, the BaseBot. They will learn how to use basic assembly tools as well as how to identify available Vex robotic components from the classroom inventory system. Students will learn the subsystems (chassis, drivetrain, electrical, control) during the BaseBot construction activity. After the robot is constructed, students will test and troubleshoot their creation. Best engineering practices require testing, troubleshooting and adjustments/modifications of a design. This is followed by reflection and re-engineering to recognize that multiple solutions are possible for a problem/challenge. The designs, troubleshooting and re-engineering possibilities will be recorded in the student journals.

Unit 4 — Wireless Interfacing

Students will experience current technologies when they interface their robots with wireless game controllers. Students will need to use their prior knowledge of electronics and begin to master the basics of Easy-C programming language that is used in the Vex robotics system. Students will program the BaseBot constructed in unit 3 to remotely control it to move in straight lines, reverse motion as well as rotate to navigate through an obstacle course. Another activity will be for the students to write their initials using their robot and a whiteboard marker within the constraints of a walled robot competition field.

Upon completion of this unit;

-Students will link a wireless receiver (attached to the robot) with a hand-held controller.

-Students will understand how wireless-controllers work and their application in our current technological world.

-Students will add related entries and reflection to their journal related to their accomplishments and acquired knowledge/skills.

-Students will complete a detailed 3-5 page report or electronic presentation to tie in everything in this unit from design to fabrication and the related physics and mathematics of robots.

Signature Assignment:

Students will program the BaseBot constructed in unit 3 to remotely control it to move in straight lines, reverse motion as well as rotate to navigate through an obstacle course. Students will have multiple opportunities to test and refine their designs for improved performance and better results (higher points).

Unit 5 — Sensors

Students are introduced to open and closed loop robotic navigation using sensors and the Easy-C program. This unit builds on the dead reckoning programs constructed in unit 3. Digital bumper switches are added to the BaseBot so that it can interpret its environment autonomously. An ultrasonic range-finding sensor is introduced to allow the robot to sense its environment without touching it. A set of advanced drive functions is taught in order to simplify the autonomous control of the speed and direction of the robot. These drive functions are used in conjunction with a line-following sensor to have the BaseBot autonomously follow a line through a portion of the competition field.

Upon completion of this unit;

-Students will further broaden their understanding of how different components (sensors, batteries, multi-controllers, motors, gears and wheels) interact with each other in unison.

-Students will master the understanding of sensors. What sensors are and what role they play in our everyday life.

-Students will become familiar with two types of sensor constructions. The first will be bumper switches on all sides of the base that will allow the robot to sense objects with which it comes in contact.

-The second sensor construction students will understand is a ground-line sensor that allows the robot follow a line through part of the designed obstacle course for this unit.

-Students will increase their Easy-C programing skills related to the sensors in this unit.

-Students will add related entries and reflection to their journal related to their accomplishments and acquired knowledge/skills.

-Students will complete a detailed 3-5 page report or electronic presentation to tie in everything in this unit related to the effects of sensors linked with a robot.

Signature Assignment:

Students must program their robots to autonomously navigate and knock down some obstacles (binders or wood blocks) while not touching others in a specified order and in a specified time range. Students will have multiple opportunities to test and refine their designs for improved performance and better results (higher points).

Unit 6 — Arms and End effectors

Students will combine elements introduced in units 3-5. An arm will be added to the BaseBot and a basic physics analysis is done on how the arm effects the overall robot design and performance. The concept of center of gravity will be understood as the construction of the arm, the end effector and the weight of an object attached to the end effector is applied. Stall torque is examined related to the arm function as well as speed and gear ratio. The student is challenged with incorporating two limit switches into the design of the arm to control its movement. An end effector (claw) is added to the arm for gripping a game object used in the final unit.

Upon completion of this unit;

-Students will understand how different components (batteries, multi-controllers, motors, gears and wheels) interact with each other in unison.

-Students will master the construction of a functioning robot with hand tools.

-Students will master installing motors, bearings and making adjustments for motion.

-Students will understand how different gear rations and different sized wheels affect the movement of the robot.

-Students will add related entries and reflection to their journal related to their accomplishments and acquired knowledge/skills.

-Students will complete a detailed 3-5 page report or electronic presentation to tie in everything in this unit from design to fabrication and the related physics and mathematics of robots.

Signature Assignment:

The student must add an arm and end effector to the BaseBot. The Basebot, arm and end effector will be added to the Easy-C program for controlling the robot. The student will navigate the robot on the competition field to retrieve one or more competition game pieces and deliver it/them to a specified goal. The student will be timed for this activity. Students will have multiple opportunities to test and refine their designs for improved performance and better results (higher points).

Unit 7 — Final or Competition Robot Capstone Project

Students will combine all elements from this course to re-design and create a competition robot. The robot will compete in a classroom based competition with new game pieces introduced in this unit. The previous robot must be modified to effectively compete in the new game. Throughout this unit students will use analytical, expository writing to document and describe their work on the project in their engineering notebooks (journals). After the competition, students will create an invention and design report that focuses on the challenges and adjustments encountered in the process resulting in their final robot

Text(s): Title: None

Edition: _____ Publication Date: _____

Publisher: _____ Author (s): _____

URL Resource(s) _____

☐ Usage ☐ Primary Text ☐ Read in entirety or near entirety

Pre-Requisites
None
Co-Requisites
None

Supplemental Instructional Material: *Please Describe. If using online text or non-standard material, please provide the title of the material or webpage and the URL link.*

Vex EDR Curriculum http://curriculum.vexrobotics.com/curriculum 13 units, and more.

Instructional Methods and/or Strategies:

Lecture and Lab

Assessment Methods and/or Tools:

Paper test (Safety), Project design and plans, Project completion, Student Journals

Activities: *(if applicable)*

Designing and producing and testing one or more robots

Certificate: *(if applicable)*

N/A