Introduction to Robotics Engineering

Berkeley High School (050290)

Submitted: Aug 10, 2017
Decision: Pending

Pending UC review

Basic Course Information

School(s) Offering This Course:

School Name	Course Learning Environment	Transcript Code(s)
Berkeley High School (050290)	Classroom Based	Abbreviation: Intro to Robotics; Course Code: AS51Y

Title: Introduction to Robotics Engineering

Length of course: Full Year

Subject area: College-Preparatory Elective ("g") / Laboratory Science – Physical Sciences

Integrated (Academics / CTE)? Yes

Grade levels: 9th, 10th, 11th, 12th

UC honors designation? No

Course Description

Course overview:

This course uses the VEX Cortex curriculum developed by Carnegie Mellon to introduce students to robotics and the engineering process. Students will learn how to design, prototype, build, and program VEX EDR robots to complete multiple challenges in the fall. Students can work at their own pace using the VEX Cortex Video Trainer. In the second semester students will use the skills they developed in the fall to build a robot to compete in the VEX Robotics Competition. Throughout the course students will keep an engineering notebook and produce online newsletters highlighting their work.

Prerequisites:
None

Co-requisites:
None

Course content:

Unit 1 - Course Overview/Team Building/Engineering Notebooks (1 Week)

Topics

This short unit is designed to set class expectations and norms, build a sense of teamwork and introduce students to the primary mode of communication, "The Engineering Notebook". Over the first week of the class, students will take part in various team-building activities and be asked to respond to prompts by writing in their notebooks. Students will also be asked to read from their notebook entries and share ideas with each other.

Example Assignment

Students will take part in a brainstorming activity called "Why Robotics?" in which they discuss reasons that STEM education is so important and what they expect to learn this year that will be useful to them in the future. They will also speculate on the future of robotics, computers and smart embedded systems.

Unit 2 - Safety, Organization and "The Engineering Process" (2 Weeks)

Topics

Students will learn the importance of lab safety and how a good attitude towards safety can prevent most accidents. Students will also learn the locations of tools and materials they will use over the course of the year. They will then learn to describe the important steps of the engineering process, which are: (1) Research, (2) Planning, (3) Prototyping, (4) Testing, and (5) Commercialization. Students will be organized into teams of 4 to take part in the first challenge, the Rube Goldberg Machine challenge. This is a fun challenge which allows students to go through the engineering process and learn the importance of each step.

Assignment

The assignment for this unit is to prototype, design, and build a Rube Goldberg machine with five distinct transfers of energy. Prototypes must first be built of raw materials (cardboard, wood, etc) and final projects must be constructed mainly of vex components. As students go through the process, they are required to record their observations and results in their notebooks. The challenge culminates in a one day demonstration of every team's machine, with a class goal of connecting different group's projects together into one giant machine.

Unit 3 - Vex Cortex Set Up Unit (2 Weeks)

Topics

In this unit, students will begin using the "VEX Cortex Video Trainer" (VCVT) to build the VEX Clawbot, configure the control system, and download a sample program. The VCVT is a video-based curriculum developed by the Carnegie Mellon Robotics Academy which allows students to work at their own pace and is rich in resources. Students will work in teams of 2 to build a VEX Clawbot using step-by-step instructions. They will become familiar with some basic tools and how to work with the VEX mechanical components. Once the Clawbot is built, they will learn how to configure the microcontroller and joystick for remote-control. At the end of the unit, students will be introduced to the RobotC software which allows them to begin writing code for their robot. They will download a sample program and upload it to the robot.

Assignment

The main assignment in this unit is completion of the Clawbot. There will also be a notebook entry which allows students to record their understanding of the set-up process.

Unit 4 - The Labyrinth Challenge/Autonomous Movement (4 Weeks)

Topics

This is the unit that introduces students to the programming language, RobotC, which is used throughout the VEX curriculum. Students will follow the videos in the "Basic Movement" unit of the VCVT. These videos teach students how to write basic code to make their robot drive forwards, backwards, turn and change speed. Students will then learn how to use encoders to refine the basic movements of the robot. They will learn how to write code that automatically keeps the robot driving straight based on encoder values.

Assignments

The main assignment will be "The Labyrinth Challenge" which is a maze marked out inside the VEX competition field that the robot must navigate through. There will be a "basic" challenge only involving movement of the robot and an "advanced" challenge which involves picking up a ball halfway through the maze and placing it in a goal at the end of the maze. Students will complete small programming challenges as they progress through the unit, such as the "Driving Straight II" challenge, in which students will set up a 7' long lane of soda cans only 2 inches wider than their robot. The robots will attempt to drive straight down the lane without hitting any cans. There will be weekly quizzes to assess programming knowledge.

Unit 5 - The Minefield Challenge/Remote Control (4 Weeks)

Topics

Students are introduced to the topic of "Remote Control" which requires them to understand how to assign or "map" robot functions to particular buttons on the joystick. Sub-topics include: timers, buttons and joystick mapping. The VCVT "Remote Control" unit will guide students through these topics. Students will also learn how to combine both "autonomous" operations and "user control" operations into a single program.

Assignments

The main assignment of this unit will be "The Minefield Challenge" which is a competition where two robots compete head to head to score as many points as possible. At the end of the unit, teams will also be required to prepare a Powerpoint presentation of the process they went through to compete in the Minefield Challenge.

Unit 6 - The Grand Challenge/Sensing (6 weeks)

Topics

This unit essentially wraps up the first semester of the class. The unit focuses on the use of sensors to improve the function of the robot. Students will begin by installing the following sensors on their robots: gyro, rang finder, integrated motor encoders, potentiometer and line tracker. They will then follow the VCVT topics in the "Sensing Unit". These topics include: how to control distance to objects with the rangefinder; how to limit and control arm movements with a potentiometer; how to refine straight movements and turns with integrated encoders and gyros; and how to follow a path using line followers. The Grand Challenge will vary from year to year but will be a competition that requires robots to use sensors in order to be successful. Students will also be allowed to design and build an additional mechanism to add to their robot for the challenge. This will give them another chance to practice the "engineering process" since they will be required to research, conceptualize, prototype and test their chosen mechanism.

Assignments

The main assignment of this unit will be "The Grand Challenge" which will be a interactive robotics competition where alliances of two robots compete head to head with other alliances. An example was the competition used this year, "Stack N Roll", where robots were required to build stacks of cubes and balance with their partners on teeter-totters. To practice their technical writing skills, students will also be required to submit a substantial Notebook Entry describing the sensors they used on their robot and how it helped them be more competitive.

Unit 7 - The VEX Robotics Competition (16 - 20 weeks)

Topics

The second semester of the course will be based around the current VEX Robotics Competition. This year (2017) it is the competition "In the Zone" which challenges robots to stack cones onto goals, move mobile goals into scoring zones, make the highest stack of cones, and park robots in particular locations at the end of the match. Students will form into teams of 2 and will be tasked with designing, building and programming a robot from scratch to compete in the VEX Robotics Competition. This will allow students to put all that they have learned first semester into practice using "The Engineering Process".

Teams will be required to develop a schedule, build prototypes of various mechanisms, integrate those mechanisms, test the whole system and then program the final robot to be able to compete. They will also be required to develop a marketing plan to raise additional funds for special parts, publish a monthly newsletter, produce a "reveal" video of their robot, and publish a comprehensive Engineering Report which documents the entire process of the design and construction of their robot.

Assignments

The main assignment will be building a robot to compete in the VEX Robotics Competition which will be an all-day event near the end of the school year. In addition students will be required to develop a marketing plan, publish 4 newsletters (e-mailed to their parents), produce a "reveal" video, write weekly work logs in their notebooks and author an Engineering Report.

Course Materials

Websites

Title	Author(s)/Editor(s)/Compiler(s)	Affiliated Institution or Organization	URL
VEX Robotics	VEX	VEX	http://www.vexrobotics.com/vexedr/competition

Multimedia

Title	Author	Director	Name of video series	Date	Website	Medium of Publication
VEX Curriculum 2.0	Carnegie Mellon	[empty]	[empty]	2016	http://www.education.rec.ri.cmu.edu/products/vex_online/main_start.htm	Website
VEX Cortex Video Trainer	Carnegie Mellon	Carnegie Mellon Robotics Academy	[empty]	2016	http://www.education.rec.ri.cmu.edu/products/cortex_video_trainer/index.html	Website

Supplemental Materials

Title	Content
Supplemental Materials	www.usfirst.org/robotics/ - This site is used in its entirety www.ifirobotics.com/ - This site is used in its entirety www.chiefdelphi.com/ - This site is used in its entirety robotics.nasa.gov - Design Challenges may be used www.firstcadlibrary.com - This site is used in its entirety www.fpef.org/ - Educational Curriculum area

Additional Information

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