

REC Unit Overviews

Overview:

This document gives a brief overview of each unit describing the topics covered and outcomes for the student. The material is taught in a step-by-step fashion, that assumes no prior knowledge of robotics by the student. Basic robotic concepts are introduced in sections labeled “Core”. Each core section is immediately followed by an activity or project to reinforce the materials introduced in the core. Each section in the curriculum builds upon the knowledge gained in the previous sections.

Some of the activities and projects are leveled either Fundamental or Advanced. The fundamental activities are written for a student with a 9th or 10th grade math and science skill set. The Advanced activities are written for a student with an 11th or 12th grade math and science skill set. The fundamental activities walk the student through some of the more difficult math and science concepts that they may not have yet been introduced to the student. It breaks these concepts down into simpler components for the student to understand and relate too. The advanced activities move at a faster pace and are more challenging, assuming the student has a higher math and science skill set. Both the fundamental and advanced activities and projects teach the exact same materials. The teacher must determine which level their class should follow. Some teachers may choose to mix the leveling in the class depending on the grade level of the students.

Unit 1 – Introduction to Robotics

Unit 1 introduces the student to the world of robotics. It reviews fundamental robotic terms and concepts required throughout the course. The student learns about the engineering design cycle and how to record information into an engineering notebook. An entire section in Unit 1 is dedicated to robotic safety in the classroom. As the student progresses through the unit, they will be constructing 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. The BaseBot construction is broken down into subsystems like chassis, drive train, wiring and radio control. After the robot is constructed, the students test and troubleshoot their creation. They learn how to operate their robot using radio control in both Arcade and Tank style. The final project challenges them to draw their initials on the playing field using the Basebot and a dry erase marker.

Unit 2 – Introduction to Vex Programming

Unit 2 introduces the student to programming. EasyC™, the block style programming language for Vex, is introduced and will be used throughout the course. The student is shown the differences between RC control of the robot and autonomous control. The student learns how to connect the BaseBot to the

computer and control it via an Online window in easyC. Students are challenged to create pseudo code for their programs before trying to create real programs in order to better understand the concept of programming flow. Fundamental programming concepts like loops, statements, variables, constants and assignments are reinforced with activities and worksheets. Students learn how to create simple programs to command the robot to go forward, backward, left and right. They learn how to simplify their code using functions. In the final project, the students are tasked to have the BaseBot follow a complex path using their new programming skills.

Unit 3 – Physics and Robotics

Unit 3 is the longest unit in the first semester as well as the most academic. It reviews many fundamental physics concepts such as speed and torque and shows how they apply to robotics. Student will learn about motors and how they are used in robotics. Time is spent testing the Vex motors on the Basebot and logging performance information into the engineering notebook for future use. Topics like angular velocity, linear motion, gear ratios, weight, friction, torque and acceleration are all introduced and reinforced with activities related to robotics. The final project challenges the student to pull a weighted sled 3 feet with the BaseBot. The BaseBot can be modified to take advantage of concepts learned within the unit.

Unit 4 – Sensors

Unit 4 introduces the student to open and closed loop robotic navigation using sensors. This unit builds on the dead reckoning programs constructed in unit 2. 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 follow a line on the playing field autonomously. In the final project, several binders are standing on end and the robot must autonomously find and knock down each binder in the specified time period.

Unit 5 – Arms and End Effectors

Unit 5 combines the elements introduced in unit 3 and 4. An arm is added to the BaseBot and a basic physics analysis is done on how the addition of the arm affects the overall robot design. Center of gravity and its importance to robotic design is introduced. Stall torque is examined on the arm as well as the speed and gear ratio. The student is challenged to incorporate two limit switches into the design of the arm to control the movement of the arm. This requires the student to create an easyC program to map the input from one of the channels on the transmitter to the motor on the BaseBot controlling the arm. An end effector is added to the end of the arm on the BaseBot using a servo motor to control the gripping range of the end effector. In the final activity, the student must program the BaseBot to drive on the playing field and retrieve ball while being controlled with the radio control.

Unit 6 – First Semester Project

This is a two-week project that reinforces all the materials covered in Units 1 – 5. The student must create a robot that can follow a line, pick up rings from the playing field, drop the rings off at a specified location and return back to the starting position. At the end of the first week, a competition will be held for the class. Students will be required to navigate the course and perform the task with their robot operated by radio control. At the end of the second week, another competition will be held. This time the robot must complete the entire task autonomously, with no user input.