REC Semester 2 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 some knowledge of robotics by the student, and familiarity with the topics covered in REC Semester 1. 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 as 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, science and programming concepts that may not have been introduced in the classroom. The Advanced activities assume the student has a higher math and science skill set, are more challenging and move at a faster pace. 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 7 - Introduction to Electronics

Unit 7 introduces students to both the theory behind and the practice of basic electronics, one of the major facets of Robotics Engineering. Assuming no prior knowledge of electronics, the unit begins with a basic review of safety around electronics, the concepts of voltage, current and resistance, as well as how to read and create electronics diagrams. Students use real components and their own breadboard to create increasingly complex circuits. Additional topics in Unit 7 include a discussion of Ohm’s law, series and parallel circuits as well as more complex components like transistors, potentiometers, photoresistors, timers and logical gates.

In the unit project, students incorporate programming on the Vex Controller with an electrical circuit on a breadboard to control a bank of LEDs.

Unit 8 - Mechanical Properties

Unit 8 reintroduces the student to working directly with Vex. Students first learn about chain and sprockets with the new chain and sprocket kit, available in the REC 2 pack. They then build a fast, durable, four-wheel drive robot called the “Tumblebot”.

After building the robot, students learn about some of the new features in the advanced version of easyC, easyC PRO. New features include the Switch and Case function blocks, support for more sensors, and the new “My Robot” feature which make writing programs faster and easier for users of all skill levels. Students learn to write their own C functions and even type the code by hand into the new text editor. Students will finally learn how to program their robots for autonomous robotics competitions.

The capstone project for Unit 8 is a freeze tag competition where all of the students

compete to see who can program and control their robot the best, while using everything they have learned in Units 7 and 8.

Unit 9 - Advanced C Programming

Unit 9 reviews a number of advanced programming concepts that are applicable to both C and other programming languages. The first three Cores and Activities are dedicated to teaching the students PID (Proportional, Integral and Derivative) control. Students learn both the theory behind PID and practice using their Tumblebots equipped with a front mounted ultrasonic sensor. Students then learn other advanced programming techniques, such as filtering out erroneous data retrieved from a sensor, using arrays, behavioral robotics and creating their own random number generator.

The final project in Unit 9 is a free design and programming activity where the students design, build and program their own “vacuuming” robot. All of the programming techniques taught in Unit 9 are designed to be both relevant to robotics, as well as other real life applications such as process control and manufacturing.

Unit 10 - Introduction to Industrial Robotics

Unit 10 combines elements of Units 8 and 9 in the study of industrial robotic arms. Students first learn about the different types and uses of robotic arms and robotic systems in industry. The students then work system by system to create a fully functional three axis robotic arm using Vex mechanical parts and sensors, including the new potentiometer available in the REC 2 pack.

After learning about the various ways to move a robotic arm, students combine a motor and potentiometer to simulate the operation of a servo. In the final project, students add conveyor belts to their robots and work together to pass an object from one robot to another, mimicking a real manufacturing environment.

Unit 11 - Advanced Mechanics

In Unit 11, students learn about various advanced mechanical systems. In the first Core and Activity, students learn about and create a chain driven lift mechanism and use a spring scale to measure the force delivered by their lift. The next section discuses different types of gears, such as worm, bevel, and helical gears as well as rack and pinion systems, differentials and transmissions. In the activity, students build two sets of rack and pinion lifts and test them to see how much each can lift.

Students also learn about the uses for collectors and roller systems in both robotics and industry. With all of these advanced mechanics under their belt, students are now ready to complete the Semester 2 project.

Unit 12 - Second Semester Project

This is a two-week project that reinforces the programming and engineering concepts covered during both semesters of REC. The student must design and build a robot that can compete in Bucket Battle, a game developed especially for REC 2 and intended to simulate the experience of real robotics competitions. Students must present a preliminary design to their teacher before building, and end the project with a critical

design review, in which they present their various design considerations, strategies and mathematical calculations.

In Bucket Battle, the team with the fewest balls at the end of the match wins. Each team or alliance must frantically collect balls from their side, and dump them over the wall onto their opponent's side in order to keep their score low. The game begins with a 15-second autonomous period, during which robots can drop special balls into a large bucket to secure points. This game was designed to incorporate all mechanical, electrical and programming aspects taught to the students throughout the year in an exciting and competitive environment.