SCARSDALE HIGH SCHOOL

INTRODUCTORY ENGINEERING COURSE CURRICULUM

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1. Overview

The Introductory Engineering[1] course is designed to introduce students to basic principles in mechanical and electrical engineering, and lay a foundation for subsequent study in engineering, applied physics and design. Students will be introduced to the basic theory of mechanics and electricity and will apply this knowledge in the form of hands-on projects. The projects are intended to make the connection for students between theory and application, as well as to teach them important tangible skills they will be using in subsequent courses in the department (and potentially in college or at a job). The course covers four main units: 1) The Engineering Design Process; 2) Mechanics; 3) Principles of Electricity; and 4) Software and Microcontrollers. The course will culminate with a final capstone project in which students apply what they have learned in units (1)-(4) in an integrated way.

2. Engineering Design Process

Topic	Notes
Definition of Engineering	
Major disciplines of engineering	
Design Process	Emphasize science/math knowledge; research; experimentation
Forces, Vectors, Newton's Laws	Discuss gravity, spring forces (Hooke's Law)
Projectile Motion, Parabolas	
Project: Fling Challenge	Design and create a device that will launch a ping pong ball as far as possible.
	Time: 6 Days

3. Mechanics

Topic	Notes
Forces, Motion, Friction	
Rotational Inertia	
Spring Constants, Potential Energy	
Mechanical Advantage, Simple Machines	
Project: Mousetrap Car	Have students optimize the car either for distance or speed
	Time: 6-8 Days

[1] Submitted by M. Kumaresan & B. McDonald

4. Electricity

Topic	Notes
Electricity, Current, Voltage	
Resistance and Ohm's Law	
LEDs, Circuit Diagrams	Resistors, LEDs and voltage sources only
Breadboarding, wiring circuits	
Measurements using multimeters	Motivate series and parallel connection when plugging in multimeters
Variable Resistors, Photo-resistors	
Project: Water Clarity Tester	Design and build a circuit and enclosure to test the clarity of the water contained in a 250ml beaker
	Time: 6 Days

5. Microcontrollers and Sensors

Topic	Notes
Python IDE Installation	Thonny or Visual Studio (recommended for Phidgets)
Python programming - Numbers and Arithmetic	
Python programming - Variables and Data Structures	
Python programming - Control Flow	if-else; for and while loops
Phidgets - build kit	Use Phidgets "Getting Started Kit"
Phidgets - blink LED, read button, buttons with LEDs	Use Phidgets "Getting Started Kit"
Phidgets - Read temperature and humidity with sensor	
Time Permitting - advanced programming with Phidgets	Events programming and the Phidgets API
Project: Thermostat	Create a simulated thermostat using Humidity Phidget, push buttons and LEDs
	Time: 8 Days

6. Final Project

The final capstone project will be assigned by the teacher at the end of the course. The goal of the project is to give students the opportunity to apply the knowledge they have acquired in the course. Ideally, the project will require students to design a device that includes a mechanical, electrical and control component. Students will be given some constraints; however, the project will allow some freedom for students to make their own design choices and apply design thinking to their final product. Some suggested final projects include:

(1) Robotic Car Challenge (Phidgets Rover Kit)
(2) Reverse Engineering
(3) Mousetrap Car (optimized for either speed or distance)