**OFFICIAL COURSE TITLE: Pre-engineering and Robotics 2**

**LENGTH OF COURSE: full year**

**CREDITS: 5**

**GRADE LEVEL**: 10-12

**COURSE PREREQUISITES: Introduction to pre-engineering and robotics, or completion of junior year**

**COURSE DESCRIPTION:**  Students explore a series of diverse engineering fields through hands-on experiences including biomedical engineering, environmental engineering, electrical engineering, robotics, and computer science..

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| **Unit 1: The Design Loop & Documentation** | **SUGGESTED TIMELINE : 15 days The unit timeline will be distributed throughout the course.** |
| **BRIEF UNIT SUMMARY: The design loop will be introduced as a strategy for problem solving and the method for approaching problems throughout the year. The steps, inventions, ideas, actions, work a student performs and evaluation of that work will be documented in a design log. Patent protection can be reliant on quality design logs. A design log will be maintained by every student.** | |
| **Unit 3: Statistical Process Control** | **SUGGESTED TIMELINE: 15 days** |
| **BRIEF UNIT SUMMARY: Students will explore processes and develop strategies to improve them. Using principles of statistical process control, students will find the standard deviation of a measurable attribute of an assembly of their own creation, i.e. weight. Students will determine the most significant factors affecting the assembly using Pareto analysis. Students will modify the procedures to make the assembly weight more consistent, reducing the standard deviation.** | |
| **Unit 3: CAD and Engineering Graphics** | **SUGGESTED TIMELINE: 25 days** |
| **BRIEF UNIT SUMMARY: Students will become skilled at making and reading CAD engineering drawings. Students will explore conventions, used in making orthographic projection drawings. Students will use common commands, (LINE, CONSTRUCTION LINE, OFFSET) and dimension the drawings using trade appropriate units. Students will also use AutoCAD to create a drawing for a 3-d printer in the .stl format.** | |
| **Unit 4: Computer Science: Microcontrollers and Microprocessors** | **SUGGESTED TIMELINE: 25 days** |
| **BRIEF UNIT SUMMARY: Students will use a micro controller to explore inputs, processes and outputs to invent a game. Using a microcontroller (BASIC Stamp or Arduinio), students will explore how to integrate sensors, i.e. switches, process the information, and the output the information-i.e. making a game piece advance. As in the spirit of open ended design, student teams are guided with their choice of game, but are invited to explore the feasibility of any of their ideas.** | |
| **Unit 5: Electrical Engineering and Speakers** | **SUGGESTED TIMELINE: 25 days** |
| **BRIEF UNIT SUMMARY: Students will explore the patents for the first speakers in the 20th century and make a speaker using a coil, permanent magnet and cone. Students will have a design objective to make a louder speaker and will apply the properties of wire, Ohm’s law, Kirchoff’s law, and properties of waves to accomplish their goal.** | |
| **Unit 6: Bio-medical Engineering** | **SUGGESTED TIMELINE: 25 days** |
| **BRIEF UNIT SUMMARY: Students will explore how a robot can be used to diagnose and replace or repair a body part. Topics will include how arteries stiffen (stenosis) and are replaced with grafts. Sensors will be used to analyze properties-color, sound, touch-analogous to human senses. Students will explore robotic surgery by making a controller for a servo motor using a microcontroller and a sensor modeling robotic surgery** | |
| **Unit 7: Environmental Engineering** | **SUGGESTED TIMELINE: 15 days** |
| **BRIEF UNIT SUMMARY: Students will explore why New Jersey has a zero-runoff requirement. Students will study the impacts of excessive water runoff and causes. They will develop plans for a rain garden in CAD for a proposed house. Student plans will be based on information garnered from a design manual from Rutgers University.** | |
| **Unit 8: Engineering and Power** | **SUGGESTED TIMELINE: 15 days** |
| **BRIEF UNIT SUMMARY: Students will explore how electrical power is produced and how it is distributed in a house. Students will review an electrical code and create using CAD, plans indicating the location of different outlets, switches and lights. Students will analyze the current of circuits, identify GFI circuits, and dedicated circuits. Students will also identify the how much power a home consumes and strategies to reduce these requirements. Students will investigate different methods of energy production and analyze the pros and cons of each method.** | |
| **Unit 9:** | **SUGGESTED TIMELINE: 15 days** |
| **BRIEF UNIT SUMMARY: Students pursue an area of personal interest in an engineering field. Options include the timely pursuit of a competition, expand upon a previous topic, extend a current topic, or investigate a new engineering topic.** | |