

Engineering & Robotics
Marlboro Central School District

Marlboro High School

This class surveys basic principles and concepts of engineering. The class exposes students to some of the major concepts that they will encounter in a postsecondary engineering course of study. Students have an opportunity to investigate engineering and high tech career paths. This class is intended to develop skills and understanding of concepts through activity, project, and problem-based learning. Used in combination with a teaming approach, learning challenges students to continually practice their social skills, creativity, and problem solving skills based upon engineering concepts. All of the previously mentioned skills and applications are all centered towards 21st Century Skills students need in order to be successful in college and in a place of business.

Class Units:

The pre-mentioned Class spans the entire school year and progressively exposes the students to STEM concepts while also using focusing on 21st Century Skills. Listed below is a detailed description of each unit in which this workshop will offer to the student body.

Unit 1: Statics/Civil Engineering

Unit Summary:

Statics is the study of engineering mechanics and specifically rigid-body mechanics. Statics is concerned with rigid bodies that are at rest. We will be using measurements of geometry and force to design bridges in class.

In this unit students will learn how to identify and calculate forces acting on a body when it is in static equilibrium. Students will calculate internal and external forces of a truss. They will use this knowledge to design, build, and test their own truss designs.

Concepts Addressed in the unit:

1. Newton's Laws: 1,2, & 3.
2. Structural integrity and material design.
3. Static equilibrium occurs when the sum of all forces acting on a body are equal to zero.
4. Applied forces are vector quantities with a defined magnitude, direction, and sense, and can be broken into vector components.
5. In a statically determinate truss, translational and rotational equilibrium equations can be used to calculate external and internal forces.
6. Free body diagrams are used to illustrate and calculate forces acting upon a given body.
7. Compare and contrast truss bridges with suspension bridges.

Unit 2: Mechanics/Mechanical Engineering

Unit summary:

Mechanisms are the basic components of most machines and consist of gears, sprockets, pulley systems, and simple machines. The effective use and understanding of mechanisms has contributed to the improvement and development of technology and society for thousands of years. The first uses of

mechanisms can be seen in the development of Paleolithic tools used for hunting, gathering, and shelter construction. Today mechanisms can be found in everyday life from the basic components of a bicycle to the high-tech equipment used in the medical industry.

In this unit students will learn how to design different types of vehicles by means of gears. There will be three different challenges where students are expected to design a specific gear set based on the objectives and goals.

Concepts Addressed in the unit:

1. Engineers and engineering technologists apply math, science, and discipline-specific skills to solve problems.
2. Engineering and engineering technology careers offer creative job opportunities for individuals with a wide variety of backgrounds and goals.
3. Technical communication can be accomplished in oral, written, and visual forms and must be organized in a clear and concise manner.
4. Most mechanisms are composed of gears, sprockets, pulley systems, and simple machines.
5. Mechanisms are used to redirect energy within a system by manipulating force, speed, and distance.
6. Mechanical advantage ratios mathematically evaluate input work versus output work of mechanisms.

Unit 3: Robotics and computer programming

Unit Summary:

From iPhones to automobiles, we use computers every day. Computers are sometimes so small and hidden that we don't even realize we're using a computer. Many of us never think about automobiles containing computers; however, today's vehicles are packed with tiny computers that regulate and monitor systems such as air bags and cruise control. How much more control will computers take from drivers in the future? What will drivers be willing to let their cars do for them? With GPS systems that provide routes and track speed, what are the barriers for autonomous cars?

In this unit students will learn how to control mechanical functions via computer software and hardware. The software communicates through a hardware interface with different inputs and outputs.

Concepts Addressed in the unit:

1. Flowcharts provide a step by step schematic representation of an algorithm or process.
2. Control systems are designed to provide consistent process control and reliability.
3. Control system protocols are an established set of commands or functions typically created in a computer programming language.
4. Closed loop systems use digital and analog sensor feedback to make operational and process decisions.
5. Open loop systems use programming constants such as time to make operational and process decisions.

Unit 4: Energy Applications

Unit Summary

Everyone uses electronic devices, but most of us do not really know what goes inside them. By learning how technology works, you become better able to control your world instead of being dependent on others to help. Knowledge of electronics can enhance your values and perspective in regards to the job sector within this realm.

In this unit students will learn by discovery. Students will be able to explain some fundamental concepts and functionality of component.

Concepts addressed in the unit:

1. Energy source classifications include nonrenewable, renewable, and inexhaustible.
2. Energy source processes include harnessing, storing, transporting, and converting.
3. Electricity will flow through closed circuits.
4. Each circuit has a specific function and each item has specific guideline on how to use for each function.

Unit 5: Material design and testing/ Aerodynamics via model aviation

Number of sessions: 60

Unit Summary:

The Build to Fly strand exposes students to the construction and flight of Flite Test designed aircraft including free flight, power flight, and multirotors.

Inquiry and Design challenges students to modify or change an existing Flite Test designed aircraft. Allowing for student practice within the engineering design model and integrating new aircraft design opportunities.

Engineering and Design challenges students to research, design, create, and test a solution to a problem ranging for a simple aircraft design to solving a real-world problem in the world of UAV.

Concepts addressed in the unit:

- 1) Soft skills include clear communication, teamwork, problem solving, flexibility and creative thinking, among others. Colleges of Engineering seek students who possess strong soft skills and who are willing to practice and grow in their personal development.
- 2) Ability to visualize a project's completion prior to its creation.
- 3) Tech savvy with willingness to adapt to the change of technology. The progress of product development requires students to be imaginative and creative to solve problems. Colleges and the engineering industry need students who have prior experience in Design Thinking to reduce "on the job training." Below is the desired basic Design Thinking process:
- 4) Use information literacy to generate solutions for an identified problem.
- 5) Use available technology to create a solution.
- 6) Perform appropriate tests needed to finalize a product. Colleges of Engineering seek students who have tried to apply their learning in technology to support their engineering pathway.