Principles of Engineering
21004

Rationale Statement:
This survey course of engineering exposes students to some of the major concepts they'll encounter in a postsecondary engineering course of study. Students have an opportunity to investigate engineering and high-tech careers and to develop skills and understanding of course concepts. Students employ engineering and scientific concepts in the solution of engineering design problems. They develop problem-solving skills and apply their knowledge of research and design to create solutions to various challenges. Students also learn how to document their work and communicate their solutions to peers and members of the professional community. This course is designed for 10th or 11th grade students.

Suggested grade level: Grades 10 to 11

Topics covered:

- **Engineering Careers**
- **Teamwork**
- **Communication Methods**
- **Global and Human Impacts**
- **Engineering Standards**
- **Technical Documentation**

Indicator #1: Explore Engineering Careers	
Bloom's Taxonomy Level	**Standard and Examples**
Analyzing	**POE1.1 Explore career opportunities in engineering** Examples: • Differentiate between engineering and engineering technology. • Conduct a professional interview and reflect on it in writing. • Identify and differentiate among different engineering disciplines.
Indicator #2: Applying Teamwork Concepts	
Bloom's Taxonomy Level	**Standard and Examples**
Applying	**POE2.1 Use the design process to create solutions by individuals or in teams** Examples: • Brainstorm and sketch possible solutions to an existing design

	problem. • Create a decision-making matrix for their design problem. • Select an approach that meets or satisfies the constraints provided in a design brief. • Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix. • Present a workable solution to the design problem.
Indicator #3: Applying Communication Methods	
Bloom's Taxonomy Level	**Standard and Examples**
Applying	**POE3.1 Create presentations** Examples: • Create and deliver a presentation to explain a specific energy source. • Summarize and reflect upon information collected during a visit to a local utility company. • Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix. • Present a workable solution to the design problem.
Indicator #4: Organize global and human impacts	
Bloom's Taxonomy Level	**Standard and Examples**
Analyzing	**POE4.1 Determine human impact on the environment** Examples: • Identify and categorize energy sources as nonrenewable, renewable, or inexhaustible. • Create and deliver a presentation to explain a specific energy source. • Summarize and reflect upon information collected during a visit to a local utility company.
Indicator #5: Implementing engineering standards	
Bloom's Taxonomy Level	**Standard and Examples**

Applying	**POE5.1 Use engineering concepts for solving mechanisms problems** Examples: • Measure forces and distances related to mechanisms. • Distinguish between the six simple machines, their attributes, and components. • Calculate mechanical advantage and drive ratios of mechanisms. • Design, create, and test gear, pulley, and sprocket systems. • Calculate work and power in mechanical systems. • Determine efficiency in a mechanical system. • Design, create, test, and evaluate a compound machine design.
Applying	**POE5.2 Use engineering concepts for solving energy sources problems** Examples: • Define the possible types of power conversion. • Calculate work and power. • Demonstrate the correct use of a digital multimeter. • Calculate power in a system that converts energy from electrical to mechanical. • Determine efficiency of a system that converts an electrical input to a mechanical output. • Calculate circuit resistance, current, and voltage using Ohm's law. • Understand the advantages and disadvantages of parallel and series circuit design in an application.
Applying	**POE5.3 Use engineering concepts for solving statics problems** Examples: • Create free body diagrams of objects, identifying all forces acting on the object. • Mathematically locate the centroid of structural members. • Calculate moment of inertia of structural members. • Differentiate between scalar and vector quantities. • Identify magnitude, direction, and sense of a vector. • Calculate the X and Y components given a vector. • Calculate moment forces given a specified axis. • Use equations of equilibrium to calculate unknown forces. • Use the method of joints strategy to determine forces in the members of a statically determinate truss.
Applying	**POE5.4 Use engineering concepts for solving materials and structures problems**

	Examples: • Investigate specific material properties related to a common household product. • Conduct investigative non-destructive material property tests on selected common household products. Property testing conducted to identify continuity, ferrous metal, hardness, and flexure. • Calculate weight, volume, mass, density, and surface area of selected common household product • Identify the manufacturing processes used to create the selected common household product. • Identify the recycling codes. • Promote recycling using current media trends
Applying	**POE5.5 Use engineering concepts for solving material properties problems** Examples: • Utilize a five-step technique to solve word problems. • Obtain measurements of material samples. • Tensile test a material test sample. • Identify and calculate test sample material properties using a stress strain curve
Applying	**POE5.6 Use engineering concepts for solving fluid power problems** Examples: • Identify devices that utilize fluid power. • Identify and explain basic components and functions of fluid power devices. • Differentiate between the characteristics of pneumatic and hydraulic systems. • Distinguish between hydrodynamic and hydrostatic systems. • Design, create, and test a hydraulic device. • Design, create, and test a pneumatic device. • Calculate values in a fluid power system utilizing Pascal's Law. • Distinguish between pressure and absolute pressure. • Distinguish between temperature and absolute temperature. • Calculate values in a pneumatic system, utilizing the perfect gas laws. • Calculate flow rate, flow velocity, and mechanical advantage in a

	hydraulic system.
Applying	**POE5.7 Use engineering concepts for solving statistics problems** Examples: • Calculate the theoretical probability that an event will occur. • Calculate the experimental frequency distribution of an event occurring. • Apply the Bernoulli process to events that only have two distinct possible outcomes. • Apply AND, OR, and NOT logic to probability. • Apply Bayes' theorem to calculate the probability of multiple events occurring. • Create a histogram to illustrate frequency distribution. • Calculate the central tendency of a data array, including mean, median, and mode. • Calculate data variation, including range, standard deviation, and variance.
Applying	**POE5.8 Use engineering concepts for solving kinematic problems** Examples: • Calculate distance, displacement, speed, velocity, and acceleration from data. • Design, build, and test a vehicle that stores and releases potential energy for propulsion. • Calculate acceleration due to gravity given data from a free fall device.
Indicator #6: Implementing Technical Documentation	
Bloom's Taxonomy Level	**Standard and Examples**
Applying	**POE6.1 Use technical documentation in design process** Examples: • Select an approach that meets or satisfies the constraints provided in a design brief. • Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix.