INTRODUCTION TO ENGINEERING DESIGN
Grade(s) 9-12

Unit 1:
Design and Problem Solving

Essential Question
How do engineers use the design process to solve real-world problems?

Unit Summary
Students will explore the engineering design process, develop problem-solving skills, and learn various modeling techniques. They will apply statistical analysis, technical sketching, CAD fundamentals, and prototyping to create and improve designs.

Guiding Questions
Content
- What are the key steps of the engineering design process?
- How does statistical analysis inform engineering design decisions?
- What role does CAD play in engineering modeling and documentation?

Process
- How can brainstorming and sketching help in developing design solutions?
- What techniques are used to improve the accuracy and precision of a design?
- How can prototypes be tested and refined using statistical data?

Reflective
- What challenges did you face in the design process, and how did you overcome them?
- How does iteration improve the final design outcome?
- What skills from this unit will be most useful in future engineering projects?

Priority Standards

- 1.1 - Identify and demonstrate knowledge in Engineering Design in historical influences, architectural styles, form and function, engineering achievements, evolution of technology and history-design and its influences on products.
- 1.2 - Explore career opportunities in engineering fields to include educational requirements, opportunities for employment and job requirements.
- 1.3 - Gain knowledge of the design process and implement the process during design challenges using teamwork and collaboration.
- 2.1 - Identify and demonstrate knowledge in the use of technology to include software, hardware, and printing.
- 2.2 - Demonstrate proper sketching techniques in the creation of Orthographic and isometric drawings.
- 2.3 Identify major geometric terms and shapes as well as demonstrate proper drafting techniques in constructing geometric forms to include polygons, triangles, circle and ellipse.
- 2.4 - Identify and demonstrate proper use of drafting equipment such as a T-Square, Compass, Divider, Triangles, and Templates.
- 2.5 - Demonstrate understanding of Orthographic views by constructing one view, two view, three view and multi-view drawings.
- 2.6 - Demonstrate proper ANSI dimensioning practices on Orthographic, section, auxiliary, and assembly's drawings and apply size and location dimensions and proper tolerance.
- 2.7 - Understand and use proper drafting techniques when constructing pictorial drawings:.
- 2.8 - Use proper techniques when creating Auxiliary drawings to include cutting plane, section lining and assembly section.
- 2.9 - Demonstrate proper techniques used in creating drawings on CAD.
- 2.10 - Demonstrate understanding of the terminology and commands:
- 3.1 - Demonstrate assembly skills to solve a variety of design problems and create sub-assemblies, drive constraints and design modifications.
- 3.2 - Understand manufacturing materials and processes creating solid models and assembly models with CNC product, 3-D parametric modeling and laser product.

- 3.3 - Recognize different machine processes used in manufacturing a product and explain the need for product efficiency throughout the manufacturing processes.
- 4.1 - Complete a presentation to include documentation that explains Engineering Design practices and product design.
- 4.2 - Demonstrate the use of visual aids in presentation, technical writing skills and communication techniques.
- 4.3 - Create a Portfolio showing evidence of the skill and understanding of Engineering Design.

Supporting Standards

- 1.1 - Create standard drawings and templates.
- 1.2 Demonstrate the ability to load, store files, and transport files via Internet.
- 1.3 - Construct isometric and 3D drawings.
- 1.4 - Use CAD drawings to produce a high or low-fidelity prototype or model.
- 1.1.1 - Demonstrate proficiency in setting limits and scale on the CAD system.
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Unit 2:
Assembly Design

Essential Question
How do engineers design and analyze complex systems of components?

Unit Summary
Students will study reverse engineering, material selection, and assembly modeling. They will learn to connect components, apply tolerances, and document assemblies using CAD software.

Guiding Questions
Content
- What methods are used to join components in an assembly?
- How does reverse engineering help in understanding product design?
- What factors influence material selection in engineering design?

Process
- How can CAD be used to create realistic assembly models?
- What techniques improve the manufacturability of a product?
- How do engineers apply tolerances to ensure proper fit and function?

Reflective
- How did reverse engineering help you understand product design?
- What challenges did you face when designing assemblies, and how did you address them?
- How might the knowledge of assembly design influence your approach to product development?

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Unit 3:
Thoughtful Product Design

Essential Question
How can engineering design be made more user-friendly, sustainable, and effective?

Unit Summary
Students will explore human-centered design, sustainability, and the product life cycle. They will use generative design, systems thinking, and project management strategies to develop practical engineering solutions.

Guiding Questions
Content
- What principles contribute to responsible and sustainable product design?
- How do material properties influence product function and durability?
- What role does human-centered design play in engineering solutions?

Process
- How can user feedback be incorporated into the design process?
- What strategies are used to analyze a product's environmental impact?
- How can generative design optimize product efficiency and performance?

Reflective
- How does considering the end-user impact engineering decisions?
- What steps did you take to make your design more sustainable?
- How will the principles of thoughtful product design shape your future engineering projects?

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Unit 4:
Making Things Move

Essential Question
How do engineers design and control motion in mechanical and electrical systems?

Unit Summary
Students will investigate motion mechanisms, forces, and electrical systems. They will apply their knowledge to develop electromechanical systems and use CAD simulations to analyze and optimize motion-based designs.

Guiding Questions
Content
- What are the different types of motion and their applications in engineering?
- How do forces like friction and gravity influence mechanical design?
- How can electrical systems be integrated to automate motion?

Process
- How can CAD simulations help in analyzing motion and optimizing designs?
- What role do cams, gears, and pulleys play in mechanical systems?
- How can mathematical models be used to predict mechanical performance?

Reflective
- What challenges did you face when designing motion systems, and how did you solve them?
- How did integrating electrical components change your approach to mechanical design?
- How might knowledge of motion systems be useful in future engineering applications?

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