

## INTRODUCTION TO ENGINEERING DESIGN (non-PLTW)

*Introduction to Engineering Design* is a fundamental pre-engineering course where students become familiar with the engineering design process. Students work both individually and in teams to design solutions to a variety of problems using industry standard sketches and current 3D design and modeling software to represent and communicate solutions. Students apply their knowledge through hands-on projects and document their work with the use of an engineering notebook. Students progress from completing structured activities to solving open-ended projects and problems that require them to develop planning, documentation, communication, and other professional skills. Ethical issues related to professional practice and product development are also presented.

- DOE Code: 4802
- Recommended Grade Level: 9
- Recommended Prerequisites: None
- Credits: 2 semester course, 2 semesters required, 1 credit per semester, maximum of 2 credits
- Fulfills a Directed Elective or Elective requirement for all diploma types

### Application of Content

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences.

## Content Standards

### Domain – Design Process

**Core Standard 1** Students perform the steps of the design process to develop and analyze products and systems.

#### Standards

- IED-1.1 Describe and apply problem solving techniques
- IED-1.2 Identify and describe the steps in the design process
- IED-1.3 Compare the design processes specific to the subject matter
- IED-1.4 Apply and adapt the design loop as a guide in creating a solution
- IED-1.5 Discuss the importance of the design process and how the process affects the outcome

### Domain – Drawing Standards

**Core Standard 2** Students integrate drawing standards to produce industry standard sketches and drawings.

#### Standards

- IED-2.1 Choose when different line types should be utilized during the drawing process
- IED-2.2 Select appropriate annotation to appropriately document features within drawings
- IED-2.3 Recognize and explain the various tolerances and their purpose
- IED-2.4 Verify sizes and shapes of objects utilizing differing measurement tools
- IED-2.5 Identify appropriate views and be able to select which should be utilized in a given situation

- IED-2.6 Develop drawings in isometric, orthographic, and perspective views
- IED-2.7 Evaluate when geometric shapes can be utilized as a part of a design
- IED-2.8 Determine how and where calculations can be made to quantify the size and locations of designs

### **Domain – Reverse Engineering**

**Core Standard 3** Students perform various analyses of systems or products with the purpose of developing improvements to those systems or products.

#### **Standards**

- IED-3.1 Perform product analyses (visual, functional, and structural) on a product
- IED-3.2 Differentiate between invention and innovation
- IED-3.3 Distinguish the relationship between reverse engineering and the next step of product/system improvement
- IED-3.4 Use information from product analyses create an innovation to a system or product

### **Domain – Project Management**

**Core Standard 4** Students manage information and data to provide better productivity through the use of engineering design process and notebook.

#### **Standards**

- IED-4.1 Justify the necessity of producing an engineering notebook
- IED-4.2 Identify the requirements for and role of intellectual property in design
- IED-4.3 Develop a working engineering notebook according to appropriate standards
- IED-4.4 Understand, develop, and implement design briefs in relation to a design problem
- IED-4.5 Understand the purpose of technical reports
- IED-4.6 Collaborate on various projects by working in design teams
- IED-4.7 Develop a Gantt chart to manage the time and progress of a project
- IED-4.8 Develop a portfolio to organize and display evidence of work

### **Domain – Engineering Design**

**Core Standard 5** Students assess the components and ethics of engineering design to understand their role in the design process.

#### **Standards**

- IED-5.1 Recognize and explain the design principles
- IED-5.2 Recognize and explain the design elements
- IED-5.3 Justify the importance of ethics in engineering design
- IED-5.4 Recognize historical and current events related to engineering design and their effects on society
- IED-5.5 Understand the effective use of engineering design equipment
- IED-5.6 Recognize and identify the role of engineering and engineered products in society
- IED-5.7 Identify the qualities of good design and their relationship to the design's user
- IED-5.8 Examine a design with respect to its quality and usability
- IED-5.9 Understand that these qualities are the result of choices made and constraints applied during the design process

## **Domain – Modeling**

**Core Standard 6** Students create designs using a variety of modeling techniques to communicate information

### **Standards**

- IED-6.1 Communicate conceptual ideas through written and verbal formats
- IED-6.2 Select the appropriate modeling materials to complete a 3-dimensional prototype or mock-up
- IED-6.3 Evaluate a sketch and generate a model using appropriate modeling materials
- IED-6.4 Recognize and explain constraints in regard to modeling
- IED-6.5 Identify the six degrees of freedom
- IED-6.6 Differentiate between assemblies and subassemblies and their appropriate use

## **Domain – Aesthetics**

**Core Standard 7** Students demonstrate artistic fundamentals which are utilized throughout the design process to solve visual problems and communicate ideas for a product or system.

### **Standards**

- IED-7.1 Identify the knowledge and skills gained in art experiences that transfer to the design process
- IED-7.2 Analyze the effective use of symbols, elements, principles, and media using appropriate terminology
- IED-7.3 Construct insightful, convincing interpretations of products or systems by identifying problematic features, forming theories, and evaluating alternative theories
- IED-7.4 Engage in critical reading, writing, and discourse to improve understanding of own work and that of others
- IED-7.5 Demonstrate skill in perception from real life to present convincing representation of objects or subject matter
- IED-7.6 Select subject matter, symbols, and ideas to communicate statements to the consumer
- IED-7.7 Engage in philosophical inquiry into the nature aesthetic issues independently or with others
- IED-7.8 Make informed choices about specific subject matter or concepts and defend those choices when given a range of objects or spaces
- IED-7.9 Appropriate symbols and metaphors from art and design and describe their origin, function, and value in the solutions
- IED-7.10 Demonstrate thoughtful revision and refinement of original design solutions based upon reflection, critique, practice, and research
- IED-7.11 Examine and establish criteria for judging excellence in work and revise and refine work through analysis, synthesis, peer critique, and self-evaluation, utilizing established criteria for the purpose of creating portfolio level work
- IED-7.12 Evaluate the effectiveness of elements and principles in other design solutions and use this evaluation to inform personal work
- IED-7.13 Create multiple solutions in works that demonstrate competence in producing effective relationships between elements, media, and function
- IED-7.14 Create design solutions that use specific elements, principles, and functions to solve problems and communicate ideas

- IED-7.15 Create design solutions that demonstrate skill and understanding of different media, processes and communicate ideas
- IED-7.16 Begin, define, and solve challenging visual problems, demonstrating skill and in-depth understanding of media and processes

### **Career and Technical Student Organizations**

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in a Career and Technical Student Organization, such as the **Technology Student Association (TSA)**.