**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).