Unit 10 Design Challenges-OPTIONAL

Unit 10 – Concepts & Objectives

Concepts	Objectives
An engineering design process involves a characteristic set of practices and steps.	• Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements.
Research derived from a variety of sources (including subject matter experts) is used to facilitate effective development and evaluation of a design problem and a successful solution to the problem.	• Utilize research tools and resources (such as the Internet; media centers; market research; professional journals; printed, electronic, and multimedia resources; etc.) to gather and interpret information to develop an effective design brief. • Utilize research tools and resources (such as the Internet; media centers; market research; professional journals; printed, electronic, and multimedia resources; etc.) to validate design decisions and justify a problem solution.
A problem and the requirements for a successful solution to the problem should be clearly communicated and justified.	• Define and justify a design problem, and express the concerns, needs, and desires of the primary stakeholders. • Present and justify design specifications, and clearly explain the criteria and constraints associated with a successful design solution. • Explain design requirements and function claims using STEM principles and practices. • Write a design brief to communicate the problem, problem constraints, and solution criteria.
Brainstorming may take many forms and is used to generate a large number of innovative, creative ideas in a short time.	• Generate and document multiple ideas or solution paths to a problem through brainstorming.
A solution path is selected and justified by evaluating and comparing competing design solutions based on jointly developed and agreed-upon design criteria and constraints.	• Jointly develop a decision matrix based on accepted outcome criteria and constraints. • Use a decision matrix to evaluate and compare multiple design solutions in order to select a solution path that satisfies the design requirements. • Clearly justify and validate a selected solution path.
Problem solutions are optimized through evaluation and reflection and should be clearly communicated.	• Describe the design process used in the solution of a particular problem and reflect on all steps of the design process. • Justify and validate a problem solution. • Identify limitations in the design process and the problem solution and recommend possible improvements or caveats.
The style of the engineering graphics and the type of drawing views used to detail an object vary depending upon the intended use of the graphic.	• Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, perspective, auxiliary, and section views.
Technical drawings convey information according to an	• Determine the minimum number and types of views necessary to fully detail a part.

established set of drawing practices which allow for detailed and universal interpretation of the drawing.	• Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings. • Create a set of working drawings to detail a design project. • Create specific notes on a technical drawing to convey important information about a specific feature of a detailed object, and create general notes to convey details that pertains to information presented on the entire drawing (such as units, scale, patent details, etc.
Dimensions, specific notes (such as hole and thread notes), and general notes (such as general tolerances) are included on technical drawings according to accepted practice and an established set of standards so as to convey size and location information about detailed parts, their features, and their configuration in assemblies..	• Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices. • Identify and correctly apply chain dimensioning or datum dimensioning methods to a technical drawing. • Identify and differentiate between size dimensions and location dimensions.
A degree of variation always exists between specified dimensions and the measurement of a manufactured object which is controlled by the use of tolerances on technical drawings.	• Determine the allowance between two mating parts of an assembly based on dimensions given on a technical drawing.
Hand sketching of multiple representations to fully and accurately detail simple objects or parts of objects is a technique used to convey visual and technical information about an object..	• Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections. • Generate non-technical concept sketches to represent an object or part to convey design ideas.
Computer aided drafting and design (CAD) software packages facilitate virtual modeling of parts and assemblies and the creation of technical drawings. They are used to efficiently and accurately detail parts and assemblies according to standard engineering practice.	• Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints. • Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice. • Create relationships among part features and dimensions using parametric formulas. • Dimension and annotate (including specific and general notes) working drawings according to accepted engineering practice. Include dimensioning according to a set of dimensioning rules, proper hole and thread notes, proper tolerance annotation, and the inclusion of other notes necessary to fully describe a part according to standard engineering practice.

	• Create sketch elements and relationships among part features in CAD using precise input (and an applicable coordinate system). • Explain each assembly constraint (including mate, flush, insert, and tangent), its role in an assembly model, and the degrees of freedom that it removes from the movement between parts. • Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement. • Create a CAD assembly drawing. Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD. • Create an exploded view of a given assembly. Identify each component of the assembly with identification numbers, and create a parts list to detail each component using CAD.
Technical professionals clearly and accurately document and report their work using technical writing practice in multiple forms.	• Organize and express thoughts and information in a clear and concise manner. • Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design. • Document information sources using appropriate formats.
Visual elements and principles of design are part of an aesthetic vocabulary that is used to describe the visual characteristics of an object, the application of which can affect the visual appeal of the object and its commercial success in the marketplace.	• Incorporate the use of the visual elements and principles of design in the design of an engineered product.
Effective design teams can improve the efficiency and effectiveness of the design process. Effective team members have good collaboration skills.	• Identify and assign team member roles. • Define the term group norms and discuss the importance of norms in creating an effective team environment. • Identify strategies to resolve team conflict.
In order to be an effective team member, one must demonstrate positive team behaviors and act according to accepted norms, contribute to group goals according to assigned roles, and use appropriate conflict resolution strategies.	• Demonstrate positive team behaviors and contribute to a positive team dynamic. • Establish common goals, equitable workloads, accountability, and create a set of team norms. • Contribute equitably to the attainment of group goals based on assigned roles. • Practice appropriate conflict resolution strategies within a team environment.

Essential Questions (Unit-Specific)

1. How might we create the best possible solution to a problem?
2. What does one need to know in order to design the solution to a problem?

Essential Questions (Course-Wide)

1. How does the design process promote the development of good solutions to technical problems?
2. How can an engineer or technical professional effectively communicate ideas and solutions in a global community?
3. How do inventors and innovators impact and shape society?