Advanced Engineering Design

Hillcrest High School (054677)

Modeled Course Outside District Approved

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asic Course Information

Title:	Advanced Engineering Design
Transcript abbreviations:	CAD 2
Length of course:	Full Year
Subject area:	College-Preparatory Elective (G) / Interdisciplinary
UC honors designation?	No
Prerequisites:	Engineering Design (Required)
Co-requisites:	Algebra (Required) Geometry (Recommended)
Integrated (Academics / CTE)?	Yes
Grade levels:	10th, 11th, 12th
Course learning environment:	Classroom Based

ourse Description

ɹurse overview:

Design and Prototyping is a course meant to bring career technical education into a 21st-century setting that synthesizes engineering and design concepts to produce real-world products. Students will learn and utilize engineering and prototyping skills along with 3D modeling to conceptualize and create solutions to problems. Students will also engage in collaborative development as they work in teams to solve real-world problems through innovation. Throughout the course, students will be presented with design problems that will test their application of engineering design principals, materials, stress, and tensile strength; as well as best design practices as they work through the Engineering Design Process with a team of fellow students. In collaboration with their teams, students will produce rapid prototypes as they work through various iterations of their final product.

A secondary focus of year two is to prepare students to sit for the Autodesk Inventor User Certification Examination. This certification demonstrates that the bearer has gathered the requisite Inventor modeling skills to enter the workforce in an entry-level design position.

ɹurse content:

Advanced Model Design

This unit will build upon Inventor skills developed in the year-1 course Engineering Design. In this Unit, students will move through a series of modeling skill tutorials in which proficiency is tested through the application of technical and 3D modeling principals in the development of mechanical parts requiring advanced modeling skills. Students will develop new parametric modeling skills in the areas of:

- Tolerances
- Springs
- Shafts
- Bearings
- Gears
- Weldments
- Cams

Each area of focus will be tested through the development of mechanical parts that focus on the specific 3D modeling skill set. In conjunction with the unit's literacy components, students will conduct research to determine best practices in terms of fasteners, materials, and necessary tolerance levels for a combustion engine.

Unit Assignment(s):

Key Assignments

Students will build the various parts contained within a V6 engine as they work through each of the unit tutorials. As a conclusion to the and content assessment for the unit, students will "assemble" the parts and create a functional animated model. Students will simultaneously test each part for functionality by 3D printing prototypes to test fit and assure that the proper tolerances are maintained to print and assemble a functional 3D printed model that functions when connected to an electric motor to drive the model engines' flywheel.

Literacy Component

Reading Chapter 17-19

TECHNICAL GRAPHICS COMMUNICATIONS, FOURTH EDITION

Product Design by Rapid Prototyping

In this unit, students working in collaborative groups will learn to combine 3d Modeling skills with the Engineering Design Cycle to produce products that solve increasingly complex engineering problems. Students will be presented will an engineering task that must be performed by a product meeting specific needs and design constraints. Using the design process together with 3D printing, students will create a series of product iterations as they work toward satisfying the specified product performance requirements. Groups will collaboratively conduct product reviews to analyze each individual groups' product and determine if the product met the performance requirements, and if not, what changes could assist the product in doing so.

Unit Assignment(s):

Key Assignment

After completing a series of designs which start from simple machines and continually become more complex in the task they must complete. Students will, in collaborative groups, be given a limited amount parts for a radio-controlled car, students will be tasked with designing the remaining parts so that the vehicle can complete an obstacle course which will assess the vehicles' ability to move and traverse complex obstacles in a given period of time. Students have the opportunity to design, test, and redesign their vehicles by rapidly prototyping parts that they have created using Autodesk Inventor and 3D printers.

Students will thoroughly document the design process.

Each group will present their vehicle to the class detailing their design process from concept to final product.

Literacy Component

Each student will write a one-page product review giving a full assessment of the presented products performance, and what post testing changes would be suggested.

Urban Concept Design

In this unit, students will be tasked with developing an Urban Concept vehicle using Autodesk Inventor. This unit is designed to test the full gambit of their 3D development skills as final preparation for the Inventor Certification Exam. The Urban Concept design will be based on vehicle requirements outlined by the Shell Eco-Marathon Engineering competition and must include all major components outlined in the competition rules. This design is intended to be utilized by students moving on to the third year Engineering Design and Development course who choose the Shell Eco-Marathon Vehicle as their Capstone Project.

Unit Assignment(s):

Key Assignment

Students will be required to design all portions of a Shell Eco-Marathon vehicle that would be fabricated as a part of the competition, in addition to the following listed components:

- Chassis
- Steering System
- Driver Seat
- Braking System
- Body
- Wheels
- Tires
- Hubs
- Rotors
- Gears
- Bearings
- Bushings
- Mounting brackets

Students must also submit one 3D printed and assembled prototype of a component to demonstrate that proper design principals and tolerances were adhered to.

Real-World Design Project

Our final unit will be a student project-centered unit where students from different backgrounds will come together to tackle an engineering problem or challenge of their choosing. These backgrounds could be art, modeling, machining, or others depending on how much experience they have had in previous classes. Groups will be tasked with researching problems or challenges in the world that do not have a decided solution and work together to conceptualize, design, and create a potential solution. This will involve research of the main issues associated with the chosen problem or challenge and synthesis of all engineering and design skills learned up to this point in their academic careers. Students will be tasked with careful and detailed note taking of related professional articles, academic papers, or even published designs of products related to their challenge. Student groups will utilize their combined research efforts to plan, design, and prototype multiple iterations of the product that could address their problem. The main requirement is that the product of their project demonstrates the Engineering Design Process through the prototype iterations produced during the design process. Groups will then select one final product to pursue and perfect through a proposal and presentation process. This can include a presentation to their group as well as a presentation to the rest of the class to have community input. A final

ourse Materials

Textbooks

itle	Author	Publisher	Edition	Website	Primar
ngineering Design Graphics with Autodesk ıventor 2020	James D. Bethune	Macromedia Press PTG	1st/2020	[empty]	Yes
ECHNICAL GRAPHICS COMMUNICATIONS, OURTH EDITION	Gary R. Bertoline, et al	McGraw-Hill Higher Education	4th/2009	[empty]	No

Other

itle	Authors	Date	Course material type	Website
410	Fusion3	12/12/19	3D Printer	https://www.fusion3design.com/
ıutodesk Inventor 2020	Autodesk	12/12/19	Software	www.autodesk.com
implify3D	Simplyfy3D	02/07/2020	Software	https://www.simplify3d.com/

design will be selected based on the successfulness of their pitches and the group will begin final redesigns and actual assembly of their final product. Once products are completed, the class will prepare more general presentations of their process to be presented in the form of a combination art show and maker fair to the school community. This could happen in tandem with other department presentations toward the end of the year (science fair presentations or normal art shows).

Projects will range depending on student backgrounds and interests. General learning achieved will be the synthesis of all engineering design skills acquired in the class as well as research and information gathering. Technical note taking skills can be introduced as well as how to read engineering designs and blueprints. Students will also work together as a team promoting the need to foster collaboration within the group. These projects will almost certainly not solve the entire researched problem or challenge but will attempt to address certain target issues. Finally, students will gain more practice and confidence in presentation skills as they pitch the designs to their groups and to the class. At the end of the year they will also present their products to a larger community.

Unit Assignment(s):

Key Assignment

Proposal

Students will be required to submit a proposal prior to the start of their "Real-World Design Project". That proposal must have the following information.

- Define the problem
- Research evidence
- Brainstorming questions answered
- Manual design sketch (Concept)
- Materials, Tools, and budget requirements
- Procedures for building the prototype
- Community member review of the design brief

Proposal requirements will be presented to students in the form of a proposal packet which will guide them through the process of developing their proposal.

Build, Test, Evaluate, and Revise

Students will continue the Engineering Design Process and prototyping iterations until they have reached a product that meets their prescribed requirements.

Students will complete a one-page product review that will be added to the students' proposal for inclusion in their pathway portfolio.