MET-2601: 3D SOLID MODELING

Cuyahoga Community College

Viewing: MET-2601 : 3D Solid Modeling

Board of Trustees:
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Academic Term:
Fall 2021

Subject Code
MET - Mech Eng/Manuf Ind Eng Tech

Course Number:
2601

Title:
3D Solid Modeling

Catalog Description:
Covers 3D modeling, design of mechanical component and system using computer-aided design technique, solid and surface model for product development, designs optimization and documentation. Includes completion of a set of production drawings created in 3D modeling environments. Emphasis on the application of geometric dimensioning and tolerancing in mechanical design and 3D modeling for enhanced part description. Students work on individual design projects that simulate real-world applications. Prepares students for SolidWorks Certification.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
3

Requisites

Prerequisite and Corequisite
MET-1230 Drawing & AutoCAD or MET-123B 2D AutoCAD for students in Smart Manufacturing program.

Outcomes

Course Outcome(s):
Create a complete set of production drawings with specified geometric and feature changes for a specified class assignment.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. Create solid model part drawings with CAD software capabilities.
2. Create a section view.
3. Create a complete 3D assembly drawing.
4. Extract orthographic views of each part.
5. Apply the proper tolerance specifications to part dimensions.

Course Outcome(s):
Re-design a product and follow it through the design process.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Use constraints effectively in part modeling.
2. Create orthographic drawings from 3D models.
3. Modify 3D models with software rendering techniques.
4. Apply materials to part for display and printing.
5. Create 3D presentation assemblies from 3D parts.
6. Utilize interference and clearance assembly analysis.
7. Create orthographic and section view of object from solid model.

Course Outcome(s):

Use AutoCAD solid and surface modeling tools to create computer model of designed object.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Demonstrate an understanding of the different phases of mechanical design.
2. Create solid model part drawings with CAD software capabilities.
3. Create 3D part models.
4. Create a section view.
5. Use constraints effectively in part modeling.
6. Create orthographic drawings from 3D models.
7. Modify 3D models with software rendering techniques.
8. Apply materials to part for display and printing.
9. Demonstrate an understanding of the computer in all phases of design process.
10. Demonstrate an understanding of the manufacturing processes of rapid prototyping that utilize 3D CAD drawings.
11. Recognize the relationship between 3D models and rapid prototyping.
12. Understand the process of rapid prototyping.
13. Create orthographic and section view of object from solid model.
14. Analyze mass and geometric properties of model created.

Course Outcome(s):

Apply proper tolerancing to drawings.

Objective(s):

1. Explain the purpose of geometric tolerancing.
2. Define size tolerancing terms.
3. Apply size tolerancing to mated parts.
4. Look up and apply size tolerances from technical charts.
5. Define the basic terms used with geometric dimensions and tolerancing.
6. Define and apply form tolerances: flatness, straightness, circularity, and cylindricity.
7. Define and apply datum: primary, secondary, and tertiary.
8. Define and apply orientation tolerances: parallelism, perpendicularity, and angularity.
9. Define and apply position tolerances for fixed and floating fastener conditions.
10. Define and apply Runout and profile tolerances: total Runout, circular Runout, line profile, surface profile.
11. Properly place geometric characteristic, material condition, and material boundary symbols in feature control frames.
12. Interpret drawing applications specifying regardless of feature size (RFS), regardless of material boundary (RMB), maximum material condition (MMC), and least material condition (LMC).
13. Explain the difference between conventional tolerancing and positional tolerancing.
14. Apply and interpret projected tolerance zone representations on drawings.

Methods of Evaluation:

1. Assignments
2. Projects
3. Tests
4. Final examination

Course Content Outline:

1. Concepts
   a. Production drawings
   b. Parametric design changes
   c. Feature-based design
   d. Geometric parameters
   e. Assembly drawings
   f. General assembly
   g. Exploded assembly
   h. Sectioned assembly
   i. View/model rendering
   j. Rendering
   k. Solid modeling
   l. Individual class project
   m. Project requirements
   n. Tolerances
   o. Design process
   p. AutoCAD surface modeling
   q. Assembly modeling
   r. Design analysis
   s. Computer aided engineering
   t. Engineering design process
   u. Concurrent Engineering
   v. Geometric Dimensioning and Tolerancing
   w. GD&T Symbols
   x. Datums
   y. Limits of Size Application
   z. Perfect Form Boundary
   aa. The Effect of Datum Precedence and Material Condition
   bb. Introduction to Geometric Characteristic and Related Symbols
   cc. Form Geometric Tolerances
   dd. Orientation Geometric Tolerances
   ee. Runout Geometric Tolerance
2. Skills
   a. Computer efficiency
   b. Software application and customization
   c. Integrating programming for individualized software application
   d. Debugging program code
   e. Design and modify parts and systems using a design process
   f. Applying and identifying the proper tolerances for a drawing
   g. Creating 2-D detail and assembly drawings
   h. Utilizing threads on drawings with the proper standards
   i. Team work and oral communication
   j. Applying Material Condition and Material Boundary Symbols
   k. Applying Regardless of Feature size and regardless of material boundary
   l. Applying Maximum Material Condition
   m. Applying Least Material Condition
   n. Applying RMB on a Primary Datum Feature
   o. Applying RMB on a Secondary and Tertiary Datum Feature
   p. Applying Virtual Condition
   q. Applying Profile Geometric Tolerances

3. Issues
    a. Working with diverse individuals and teams
    b. Developing a level of comfort with the computer and software
    c. Developing a positive attitude about using tools of the engineering field
    d. Presenting solutions using a problem-solving process

Resources

Bethune, James. *Engineering Design Graphics with Autodesk Inventor 2017*. Pren Hall, Saddle Creek, NJ., 2017.

Madsen, David A. *Engineering Drawing and Design*. 6th ed. Cengage Learning, 2017.

Planchard, David C. *Engineering Design with Solid Works 2019*. SDC Publications, 2019.

Madsen, David A. and David P. Madsen. *Geometric Dimensioning and Tolerancing*. 9th ed. The Goodheart-Wilcox Ci, 2013.

Plantenberg, Kirstie. *Engineering Graphic Essentials with AutoCAD 2017 Instruction*. SDC Publications, 2017.

Shih, Randy H. *Parametric Modeling with Autodesk Fusion 360*. SDC Publications, 2018.

Resources Other

1. AutoCAD and Inventor software.
2. Laboratory exercise handout.

Top of page
Key: 2932