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Course Outline for DSNT 66A

MECHANICAL DESIGN CONCEPTS

Effective: Fall 2002

I. CATALOG DESCRIPTION:
DSNT 66A — MECHANICAL DESIGN CONCEPTS — 3.00 units

Continued refinement of the principles of Mechanical Design Technology through original design and analysis, application of descriptive geometry, auxiliary views and revolutions to mechanical detail drawings and geometric tolerancing applied to complete design assemblies.

1.50 Units Lecture 1.50 Units Lab

Prerequisite
DSNT 52 - Technical Graphics
with a minimum grade of C

Grading Methods:
Letter Grade

Discipline:

	MIN
Lecture Hours:	27.00
Lab Hours:	81.00
Total Hours:	108.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

Before entering the course a student should be able to:

A. DSNT52
1. describe engineering design process and concurrent engineering design approach;
2. list and describe 3-D (three-dimensional) modeling and analysis techniques used in design;
3. identify the traditional tools and associated terms used to create technical drawings;
4. identify and explain the function of the primary components of a CAD system;
5. demonstrate correct hand and CAD-lettering practices as well as knowledge of linetypes;
6. understand the importance of sketching and how it integrates into the design process;
7. develop visualization skills to clearly represent and control mental images;
8. explain and construct geometry and geometric conditions that occur between entities;
9. precisely maneuver in coordinate space within 2-D and 3-D coordinate systems;
10. create and edit multiview drawings using hand tools or CAD, solving elementary design problems;
11. create an isometric and/or oblique drawing or sketch;
12. explain auxiliary view projection theory and create auxiliary views of inclined planes;
13. use fundamental descriptive and spacial geometry methods to analyze graphic models;
14. apply cutting planes to create section views using conventional practices;
15. apply standard dimensioning and tolerancing notations to mechanical drawings;
16. identify and draw geometric dimensioning and tolerancing symbols;
17. develop a basic understanding of fastening devices, manufacturing tools, production processes, and their effects on the finished product;
18. describe how working drawings provide data to make part or assembly of final design;
19. describe possible career paths in Design Technology and initiate résumé preparation.

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. visualize, sketch, and draw detail parts of assemblies using symbols and concepts;
B. recognize the significance of 2-D and 3-D CAD integration into design process, design intent and geometric problem-solving;
C. apply visualization by solids and surfaces to analyze and accurately display multiview drawings with complex limiting elements, hidden features, and intersecting cylinders and planes;
D. utilize technical mathematics to solve geometry problems related to the design;
E. apply descriptive geometry solutions to three-dimensional problems;
F. identify the basic conditions for plane representation and projection;
G. differentiate between precision and accuracy while acquiring knowledge of tolerancing;

H. become familiar with geometric controls and tolerancing rules, symbology, and modifiers;
I. develop an understanding of datums and datum systems;
J. apply knowledge of manufacturing practices, industrial materials, instrumentation, and fabrication specifications to the design of castings, forgings, sheet metal, weldments, and machined parts;
K. develop complex mechanical detail drawings with computer-aided design system.

V. CONTENT:

A. Review of the Fundamentals of Technical Graphics
1. Pictorial sketching techniques according to ASME Y14.4
2. Multiview sketching techniques according to ASME Y14.3
3. Size and Format issues according to ASME Y14.1
4. Lettering and Line Conventions according to ASME Y14.2
5. Dimensioning according to ASME Y14.5

B. The Design Process
1. Need and importance of modeling and drawing
2. Meaning and purpose to engineering graphics

C. Integration of 3-D modeling techniques into design process
1. Evaluate the effectiveness of a 3-D modeling system
2. Common construction techniques used in model building
3. Role of projection theory in displaying 3-D models on the computer
4. Apply transformations and Boolean operations to 3-D objects
5. Compare constraint-based and feature-based modeling strategies
6. Compare 2-D with 3-D CAD
7. Overcoming different data exchange standards
8. Analysis and application

D. Fine tuning the Multiview Drawing
1. Fundamental views of edges and planes
2. Multiview representations of 2-D primitives and 3-D solids
a. Limiting elements
b. Hidden features
c. Fillets, rounds, chamfers
d. Runouts
e. Elliptical surfaces and irregular curves
f. Intersecting cylinders and planes
3. Multiview drawing visualization
a. Projection Studies
b. Physical model construction
c. Adjacent areas and similar shapes
d. Surface and vertex labeling
e. Analysis by solids and surfaces
4. Partial views and revolution conventions

E. Axonometric Projections
1. Isometric, dimetric, and trimetric projections
2. Oblique drawings
3. Perspective

F. Threads and Fasteners
1. Threads
a. Terminology and specifications
b. Using thread tables
c. Thread drawings
2. Design for Assembly
3. Standard Bolts, Studs, and Screws
a. Bolts and nuts
b. Head style design
c. Cap screws and Machine screws
d. Set Screws
e. Locking devices
4. Nonthreaded Fasteners
a. Plain and Lock Washers
b. Pins, Keys, Rivets, Retaining Rings
5. Springs

G. Mathematical Tools for Analysis
1. Geometric Formulas
a. Calculating areas, circumferences, perimeters, diameters, and volume
b. Conversions
c. Formulas for mass properties, center of gravity

H. Sectional Views
1. Types and practices
2. Standard drawing conventions

I. Auxiliary Views
1. Methods of construction
2. Classification of views
3. Successive Auxiliary views
4. Dihedral angles
5. True size of Oblique Surface

J. Descriptive Geometry
1. Notational elements
2. Points and Lines
a. Visibility of lines
b. Parallelism and perpendicularity
c. Intersecting and nonintersecting perpendicular lines
d. Points on lines
e. Shortest distance and angular relationships between points and lines
3. Representation of Planes
a. Principle planes, vertical planes, oblique planes
b. True length lines on planes
c. Edge view of a plane
d. True size of oblique plane
e. Shortest distance and angular relationships between points and planes or two planes

4. Piercing Points
    a. Relationships
    b. Methods of construction
5. Revolution/Rotation
    a. Revolution of a point, line, plane
    b. Revolution of a solid
    c. CAD-generated Revolutions

K. Geometric Tolerancing (ASME Y14.5M-1994)
1. Symbols and Terms
    a. Geometric characteristic symbols
    b. Feature control frame
    c. Virtual condition, MMC, LMC, FIM, RFS, basic dim
2. Datums and Inspection devices
3. General Rules
4. Specifying zone, use of modifiers, use of datums
5. Form Tolerances
6. Profile Tolerances
7. Orientation Tolerances
8. Runout Tolerances
9. Positional Tolerance
    a. Location Applications
        1. Analysis of fixed and floating fasteners
        2. Noncircular features
        3. Multiple patterns of features
    b. Coaxial Applications
        1. Calculations
        2. Zero tolerance at MMC
10. Locational Tolerances

L. Manufacturing Processes and Manufacturability
1. Machine Tool Operations Review
2. Surface Texture Specification and Symbology
3. Production Processes
    a. Casting, Extruding, Forging, Stamping, Punching
    b. EDM and ECM
4. Heat Treatment
5. Automated Manufacturing Processes

M. Sheet Metal Process Drawings

N. Weldments
1. Welding Processes
    a. Gas and Arc Welding
    b. Resistance Welding
2. Welded Joint Types
3. Welding symbols
4. Weld Types and drawing documentation
5. Weld length and increments

O. Intersections and Developments
1. Intersections
    a. Visibility
    b. Intersection of two lines
    c. Intersection of a line and a plane
    d. Intersection of two planes
    e. Intersection of a plane and a solid
    f. Intersection of two solids
2. Developments
    a. Classifications
    b. Parallel-Line Developments
    c. Solids Developments
    d. Transitional Piece Developments

VI. METHODS OF INSTRUCTION:
A. **Lecture** -
B. **Demonstration** -
C. **Projects** - Homework and projects
D. Practical examples
E. **Guest Lecturers** - Guest speakers with specific expertise
F. **Field Trips** - Field trips and site observation as needed
G. **Discussion** - Team discussion and problem-solving

VII. TYPICAL ASSIGNMENTS:
A. Reading: 1. Read Chapter 8 on Multiview Drawing and explain the difference between first- and third-angle projection. 2. Read pgs. 726-730 on geometric tolerancing datums and be able to discuss datum uses and selection criteria. B. Homework: 1. How does cylindricity differ from circularity? 2. You are designing a heavy casting and wish to specify flatness only in a .50 x 1.00 area of a large surface. Make a sketch of the controlled area and specify a flatness tolerance of .001. Omit dimensions. 3. Determine the center of gravity and the volume of the mount. C. Problem-solving drawings: 1. Redesign the welded workpiece shown below into a casting. Include all dimensions and at least five notes, several of which should be directed to the patternmaker. Include the following changes: Finish bottom surface, bosses and left side, add fillets and rounds, and add a boss to front and back of hole “B”. 2. Redesign the pictured chain lock assembly to include a quick release fastener mechanism. Each detail drawing should be enclosed on a title block with tolerancing and three general notes. An assembly drawing should be included with a bill of materials. A written justification with five strengths of the design should be included.

VIII. EVALUATION:
A. **Methods**

B. **Frequency**

1. Frequency:
    a. Weekly graded assignments

b. One midterm and one final examination
c. One semester-long project

IX. TYPICAL TEXTS:

1. Lamit, Gary *Technical Drawing and Design.*, West Publishing Company, 1994.
2. Jensen, Helsel, and Short *Engineering Drawing and Design.* 5th ed., Glencoe, McGraw-Hill, 1996.
3. Wilson, Bruce *Design Dimensioning and Tolerancing*., Goodheart-Willcox Company, Inc., 1996.
4. Giesecke, Mitchell, Spencer, Hill, Dygdon, Novak *Technical Drawing.* 10th ed., Macmillan Publishing Company, 2000.
5. Marrelli, Richard S. and McCuistion, Patrick J. *Geometric Tolerancing.* 3rd ed., Glencoe,/McGraw-Hill, 2001.
6. Bertoline, Wiebe, Miller, & Mohler *Technical Graphics Communication,.* 2nd ed., McGraw-Hill, 1997.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Computer use certificate
B. Zip disk or several 3 1/2"diskettes