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## Course Outline for ENGR 22

### ENGINEERING DESIGN GRAPHICS

Effective: Spring 2016

#### I. CATALOG DESCRIPTION:

ENGR 22 — ENGINEERING DESIGN GRAPHICS — 3.00 units

Introduction to the engineering-design process, and to technical graphic communications tools used by engineers. Conceptual design of products. Development of spatial reasoning skills. Orthographic and axonometric projection-drawing techniques. Tolerance analysis for fabrication. Documentation of designs through engineering working drawings. Use SolidWorks Computer-Assisted Drawing software as a design tool. Basic CAD 3-Dimensional solid-modeling. Strongly recommended: Mathematics 38, and English 1A . 2 hours lecture, 3 hours laboratory.

2.00 Units Lecture 1.00 Units Lab

#### **Strongly Recommended**

MATH 38 - Trigonometry with Geometry  
with a minimum grade of C

ENG 1A - Critical Reading and Composition  
with a minimum grade of C

#### **Grading Methods:**

Letter Grade

#### **Discipline:**

	<b>MIN</b>
<b>Lecture Hours:</b>	36.00
<b>Lab Hours:</b>	54.00
<b>Total Hours:</b>	90.00

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

#### III. PREREQUISITE AND/OR ADVISORY SKILLS:

**Before entering this course, it is strongly recommended that the student should be able to:**

- A. MATH38
- B. ENG1A

#### IV. MEASURABLE OBJECTIVES:

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

1. explain the engineering design process
2. develop technical sketches
3. demonstrate use of computer aided drawing (CAD) tools
4. demonstrate and discuss visualization techniques
5. apply engineering geometrics
6. construct graphic construction, e.g., planes, angles, surfaces
7. construct axonometric projections
8. construct perspective projections
9. construct auxiliary views
10. construct section views
11. dimension drawings with a basic knowledge of tolerances
12. describe the fundamental concept of geometric dimensioning and tolerancing (gd&t)
13. define and explain thread and fastener applications
14. define and apply working drawings
15. strengthen ability to analyze spatial relationships
16. solve three-dimensional problems by descriptive geometry techniques

#### V. CONTENT:

- A. Use of traditional and computer-aided design (CAD) tools
  1. Free-hand sketching techniques, including use of scales, triangles, protractors, compasses

2. CAD command syntax, sequence, and function
3. Drawing strategy and file management
- B. Design visualization
  1. Sketches
  2. Models
  3. Connection between drawings and objects
- C. Developing orthographic projections
  1. One-view drawings
  2. Two-view drawings
  3. Three-view drawings
  4. Technical sketches
  5. Auxiliary views
  6. Section views
- D. Developing pictorial projections
  1. Isometric projection
  2. Oblique projection
  3. Single-point perspective
  4. Two-point perspective
- E. Using graphic construction
  1. Planes
  2. Angles
  3. Surfaces
  4. Lines
- F. Dimensions
  1. Application to orthographic and axonometric projections
  2. Tolerancing
  3. Geometrical dimensioning/positioning and tolerancing overview
  4. Detail, subassembly and assembly review drawings
- G. Working drawings
  1. Detail drawings
  2. Sub-assembly drawings
  3. Assembly drawings
  4. Parts lists
  5. Review actual working drawings
- H. Piercing points
  1. Auxiliary view method
  2. Two-view method
- I. Intersection of planes
  1. Piercing point method
  2. Auxiliary view method
  3. Cutting plane method
- J. Angle between planes
  1. Dihedral angle – given line of intersection
  2. Dihedral angle – line of intersection not given
- K. Vectors
  1. Resultant of concurrent coplanar vectors
  2. Resolution of a vector into concurrent coplanar components
  3. Resultant of concurrent non-coplanar vectors
  4. Resolution of a vector into concurrent non-coplanar components
  5. Velocity vectors
- L. Intersection of planes with solids
  1. Plane and pyramid intersection
  2. Plane and right circular cone intersection
  3. Plane and prism intersection
  4. Plane and cylinder intersection
- M. Developments
  1. Development procedures
    - a. Radial line
    - b. Parallel line
- N. Use of SolidWorks CAD software

## VI. METHODS OF INSTRUCTION:

- A. **Discussion** - Review of and discussion about actual engineering drawings and designs 1. Reading from the text and handouts 2. Completion of tutorial exercises 3. Group problem solving exercises 4. Homework assignments, i.e., producing drawings and sketches using CAD and/or sketches, and constructing three-dimensional physical models 5. In-class use of drafting tools and computers
- B. **Lecture** -
- C. **Demonstration** - Computer demonstration

## VII. TYPICAL ASSIGNMENTS:

- A. Reading:
  1. Read "Dimensioning," Chapter 15, Technical Graphics Communication, and be prepared to discuss how complete dimensions are applied to a drawing.
- B. Practical Exercises:
  1. Read "Angle Between Two Planes," Chapter 12, Technical Graphics Communication, and be prepared to determine the angle between two intersecting planes.
  2. Watch demonstration and powerpoint on Geometric Dimensioning and Tolerancing in *Solidworks*, and be prepared to demonstrate how to create a position tolerance.
- C. Drawings:
  1. Sketching and lettering
  2. Geometric construction
  3. Multiview drawings
  4. Assembly drawings
  5. Section drawings
  6. Toleranced drawings
  7. Auxiliary view drawings
  8. Perspective drawings
  9. Axonometric projection drawings

## VIII. EVALUATION:

### A. **Methods**

1. Exams/Tests
2. Quizzes
3. Portfolios
4. Projects
5. Group Projects
6. Class Participation
7. Class Work
8. Home Work
9. Lab Activities
10. Other:
  - a. Drawing and CAD Assignments
    1. Student project
    2. Class participation
      - a. Topic discussions
      - b. Homework discussions
    3. Examinations
      - a. Quizzes
      - b. Midterms
      - c. Final Exam

### B. **Frequency**

1. Drawing exercises daily
2. Student project once per semester
3. Class participation weekly
4. About 2-8 quizzes per semester
5. 2 midterm exams per semester
6. 1 final exam per semester

## IX. TYPICAL TEXTS:

1. Bertoline, Gary, Eric Wiebe, Nathan Hartman, and William Ross. *Technical Graphics Communication*. 4th ed., McGraw Hill, 2008.
2. Bethune, James. *Engineering Design and Graphics with Solidworks 2014*. 1st ed., Pearson, 2014.
3. Howard, William, and Joseph Musto. *Introduction to Solid Modeling using SolidWorks*. 1st ed., McGraw Hill, 2013.
4. Giesecke, Frederick, Alva Mitchell, Henry Spencer, Ivan Hill, John Dygdon, James Novak, and Robert Loving. *Modern Graphics Communication and SolidWorks 09-10 Student Design Kit Package*. 4th ed., Pearson, 2009.

## X. OTHER MATERIALS REQUIRED OF STUDENTS:

- A. Drafting pencils, scales, erasers
- B. External data storage device