ENGR 0151 - ENGINEERING GRAPHICS

Catalog Description

Formerly known as ENGR 22A and ENGR 22B
Prerequisite: Completion of MATH 27 with grade of "C" or better
Hours: 108 (54 lecture, 54 laboratory)
Description: Covers the principles of engineering drawings in visually communicating engineering designs and an introduction to computer-aided design (CAD). Topics include the development of visualization skills; orthographic projections; mechanical dimensioning and tolerancing practices; and the engineering design process. Assignments develop sketching and 2-D and 3-D CAD skills. The use of CAD software is an integral part of the course. (C-ID ENGR 150) (CSU, UC)

Course Student Learning Outcomes

- CSLO #1: Interpret, analyze, and create orthographic drawings both by hand and with a computer.
- CSLO #2: Interpret, analyze, and create drawings which include auxiliary and sectional views.
- CSLO #3: Interpret, explain, and create drawings that include dimensions and tolerances that are produced to an industry standard. Example ANSI or ASME standard (American Society of Mechanical Engineering).
- CSLO #4: Create various geometric constructions, using mathematical techniques, both by hand and with a computer.
- CSLO #5: Read, analyze, and create graphical solutions to descriptive geometry problems.
- CSLO #6: Create 3D digital solid models utilizing engineering software.

Effective Term

Fall 2023

Course Type

Credit - Degree-applicable

Contact Hours

108

Outside of Class Hours

108

Total Student Learning Hours

216

Course Objectives

Lecture Objectives:
Technical Sketching
1. Explain the use of and importance of freehand sketching in technical drawing
2. Describe the materials used in freehand sketching
3. Create freehand sketches using correct sketching techniques
4. Demonstrate the application of proportion in freehand sketching
5. Demonstrate the process of developing single view, multiview, and pictorial freehand sketches
Geometric Constructions
1. Name and describe the characteristics of geometric entities
2. Demonstrate the methods used in applying geometric constructions to Create/combine/modify 1D, 2D, & 3D geometry
Pictorial Drawings
1. Define the advantages and disadvantages of using multi-view, axonometric, oblique, or perspective drawings to represent objects
2. Construct a drawing utilizing isometric techniques (hand & CAD)
3. Construct a drawing utilizing orthographic techniques (hand & CAD)
4. Construct an iso and ortho drawings using angular and linear measurement conversion
5. Create dimensioned isometric and orthographic drawings (CAD)
6. Create drawings containing a sectional view (hand & CAD)
7. Create drawings containing an auxiliary view (hand & CAD)
8. Describe the characteristics of oblique drawings
9. Describe the effect of choice of receding axis angle in oblique drawings
10. Describe the effect of scaling receding axis in controlling distortion
11. Construct a drawing containing oblique circles and curves
12. Construct a drawing containing an oblique sectional view
13. Describe the difference between the three types of perspective drawings
14. Create and analyze drawings for true-size geometry
15. Analyze the graphical representation of descriptive geometry
16. Create and analyze 3D models
17. Print scaled 2D sheets and 3D models to ANSI standards Y18.5 2018
Laboratory Objectives:
Introduction to 2D & 3D Computer Aided Design (CAD) Software
1. Describe the layout of the CAD GUI / user interface
2. Describe the use of the command structure of CAD software
3. Demonstrate the use of coordinate systems with CAD software for creating geometry in 2D and 3D
4. Demonstrate use of the commands and methods used in the creation and modification of geometry in 2D and 3D
5. Demonstrate construction and use of drawing template files
6. Describe the proper application of engineering line types (ANSI Y18.5, 2018)
7. Create a production of scaled sheet drawings
8. Create a 3D print (rapid prototype)
Technical Sketching
1. Describe the materials used in freehand sketching
2. Create freehand sketches using correct sketching techniques
3. Demonstrate the application of proportion in freehand sketching
4. Demonstrate the process of developing single view, multiview, and pictorial freehand sketches
Geometric Constructions
1. Describe the characteristics of geometric entities
2. Demonstrate the methods used in applying geometric constructions (CAD and free-hand drawings)
Orthographic Projection – Hand drawing
1. Explain the differences between first angle projection and third angle projection
2. Demonstrate the proper choice of views and their arrangement
3. Demonstrate the proper use of hidden and center lines
4. Demonstrate the process of visualizing and representing normal, inclined, and oblique lines and surfaces
5. Create a technical drawing including sectional views
6. Create a technical drawing including auxiliary views
7. Use the techniques of geometric constructions to solve for the true size of lines and planes

8. Use the techniques of geometric constructions to represent lines, planes and solids according to engineering standards
Orthographic Projection – CAD
1. Demonstrate the construction, editing, and use of prototype drawing files
2. Demonstrate the methods of setup of proper drawing attributes
3. Demonstrate the construction of multiview drawings using standard conventions, placement, and alignment
4. Demonstrate the representation of machine elements in drawings
5. Create a 3D model which includes all standard orthographic views
6. Create a 3D model which includes sectional and auxiliary views
Orthographic Projection Dimensioning – Sketching
1. Demonstrate the application of basic dimensioning concepts to orthographic sketches
2. Demonstrate the correct application of inch and metric units on sketches
3. Demonstrate the application of the conventions and standards of ANSI Y18.5 2018 to orthographic sketches
VII. Orthographic Projection Dimensioning – CAD
1. Demonstrate the application of the conventions and standards of ANSI Y18.5 2018 on orthographic CAD drawings
2. Define and apply CAD dimension variables as used in orthographic CAD drawings
3. Demonstrate the application of tolerancing per the standards of ANSI Y18.5 2018 on orthographic CAD drawings
Sectional Views
1. Demonstrate the process of cutting plane placement to expose interior features
2. Apply the standards and conventions for lines used in section drawings
3. Identify the common material symbols used in section lining
4. Create a section drawing given two/three external orthographic views
5. Identify the seven types of sections used in drawing development
6. Demonstrate the techniques for representation of ribs, webs, and spokes in sectional views
7. Demonstrate the appropriate use of partial views in drawing development
8. Apply the conventions for application of conventional breaks to drawings
Auxiliary Views
1. Identify principal, inclined, and oblique planes and lines in orthographic drawings
2. Demonstrate the use of folding lines in the construction of auxiliary views
3. Demonstrate the use of folding lines in the construction of auxiliary views
4. Differentiate between the three types of auxiliary views
5. Create a drawing showing the true measure of a dihedral angle
6. Construct a drawing utilizing a partial auxiliary view
7. Construct a drawing utilizing an auxiliary sectional view
8. Construct a drawing utilizing a secondary auxiliary view
Threads and Fasteners
1. Apply the ANSI/Metric Standards for application specific conventions
2. Define screw thread terms
3. Differentiate between screw thread forms
4. Describe the difference between right/left hand threads
5. Apply thread pitch and lead to a thread drawing
6. Describe the difference between single and multiple threads
7. Construct drawings that employ thread and fastener standard symbology
8. Construct appropriate representations for threads in section views
9. Differentiate between the American National, Unified and Metric thread series
10. Differentiate between the American National, Unified, and Metric thread fits
11. Construct thread notes on drawings for part description
12. Construct representations of threads and fasteners in drawings
13. Construct representations of keys in drawings
14. Construct representations of springs in drawings
Pictorial Drawings
1. Define the advantages and disadvantages of using axonometric, oblique, or perspective drawings to represent objects
2. Construct a drawing utilizing isometric and nonisometric lines
3. Construct an isometric drawing using angular to linear measurement conversion
4. Construct a drawing containing isometric circles and curves
5. Construct a drawing containing an isometric sectional view
6. Construct a dimensioned isometric drawing
7. Describe the characteristics of oblique drawings
8. Describe the effect of choice of receding axis angle in oblique drawings
9. Describe the effect of scaling receding axis in controlling distortion
10. Construct a drawing containing oblique circles and curves
11. Construct a drawing containing an oblique sectional view
12. Construct a dimensioned oblique drawing
13. Describe the difference between the three types of perspective drawings

General Education Information

- Approved College Associate Degree GE Applicability
- CSU GE Applicability (Recommended-requires CSU approval)
- Cal-GETC Applicability (Recommended - Requires External Approval)
- IGETC Applicability (Recommended-requires CSU/UC approval)

Articulation Information

- CSU Transferable
- UC Transferable

Methods of Evaluation

- Problem Solving Examinations
  - Example: Example 1: Name five different line types discussed in the text and during lecture. Explain where and when each one would be used. Draw (create) an example of each on the paper. Example 2: Briefly explain when a sectional view should be used within mechanical drawing. Example 3: Describe the difference between nominal, basic, limit, and tolerance dimensions and give an example of each.
- Skill Demonstrations
  - Example: Example 1: Give the geometric object that includes an inclined plane, use orthographic projection to create a new drawing which includes an auxiliary view of this plane that is shown in true size. Measure the true size area of the inclined plane (on computer, CAD software). Example 2: Given the mechanical assembly drawing, create dimensions for all geometry in accordance with the ASME standard (American Society of Mechanical Engineers).

Repeatable

No

Methods of Instruction

- Laboratory
- Lecture/Discussion
- Distance Learning

Lab:

1. Example
2. Analyzing Oblique lines. The instructor will prepare and deliver a lecture to clearly explain how to analyze oblique lines. The lecture will be delivered first covering the applications of oblique lines, then explaining the theory of how to analyze oblique lines, and finally the instructor will use CAD software to demonstrate the techniques explained and perform several examples. Students will then be required to complete several assignments where they demonstrate these techniques. Example 2: Students will be assigned readings in the text and attend a lecture given on techniques of creating a solid model given a sketch. During this lecture the instructor will verbally describe the procedure of creating a solid model. While in lab, utilizing their notes, students will use software to create their own solid model given an assigned sketch.

Lecture:

1. Lecture: Critical Thinking: Weekly lecture and discussion sessions will present to the students engineering drawing methodology that the student will synthesize and apply to problems assigned weekly in the formulation of solutions utilizing correct engineering drawing techniques. Discussion: The instructor will assign readings from the textbooks and supplemental materials that the students will read in preparation to join in group discussions lead by the instructor during the lecture/discussion sessions and apply to weekly assigned laboratory problems. (Lecture Objective - Pictorial Drawings #1) Scenario of a weekly class session: A. Return of previous weeks graded drawings B. Comments and discussion on graded work C. Lecture and discussion of current weekly topic C
2. Why this is relevant and where you will see this in engineering and society C
3. The theory or 'how to do it' of the particular topic (example: orthographic projection) C
4. Some instructor led examples demonstrating this topic C
5. Some group work for students to do on the same topic D. Overview of weekly lab assignment (drawings) to be completed by students.

Distance Learning

1. Example 1: Students will attend a video lecture given by the instructor on creating technical hand sketch that are scaled isometric representations of actual objects. Students will then also be assigned reading (websites) on the same subject matter. They will then use those techniques to create their own drawing, by hand, which will then be uploaded to the Canvas website for evaluation by the instructor. Example 2: Students will be assigned required reading of a section of a chapter in the textbook in the previous student contact. The instructor will pose a discussion on this topic to which the student must post (to be evaluated). The student will then consume online content created by the instructor on the Canvas website (Pages or Modules) which may include websites/urls, original content generation, YouTube videos, wikis, etc. By the end of the online session, once the student has consumed all content, the student will be asked to expand upon the previous discussion post in order to demonstrate a further understanding. This will also be evaluated.

Typical Out of Class Assignments

Reading Assignments

Required college level readings from chapters in the textbooks assigned weekly. Students are expected to participate in the lecture/discussions based upon these readings. Example 1: Construct a drawing, based upon Chapter 3: Geometric Constructions, demonstrating the weekly-learning objectives. These weekly drawings are either freehand sketches or computer aided design (CAD) generated. The drawings are evaluated for compliance to American National Standards Institute (ANSI)standard. Critical thinking and problem solving are part of these assignments. Example 2: Search the Internet for articles on the development of current ANSI standards.

Writing, Problem Solving or Performance

College level problem solving and/or writing assignments are regularly utilized. Problem solving and skill demonstrations are crucial to any successful basic engineering drawing course. Example 1: Calculate appropriate tolerances and allowances from ANSI tables for mating parts in an assembly. Example 2: Solve the problem of the construction of orthographic sketches from a pictorial drawing.

Other (Term projects, research papers, portfolios, etc.)

Create a final project which is a complete set of engineering plans that one can use to build a mechanical assembly. This will include a nice binding, table of contents, assembled view, an exploded view, orthographic drawings of all individual parts, and a parts list.

Required Materials

- Technical Drawing
  - Author: Giesecke and others
  - Publisher: Prentice Hall
  - Publication Date: 2016
  - Text Edition: 15th
  - Classic Textbook?:
  - OER Link:
  - OER:
- AutoCAD and its Applications - Basics
  - Author: Shumaker,T. and Madsen,D.
  - Publisher: Goodheart-Willcox Co.
  - Publication Date: 2020
  - Text Edition: 27th
  - Classic Textbook?:
  - OER Link:
  - OER:

Other materials and-or supplies required of students that contribute to the cost of the course.

Sketch paper 1 - Flash Drive