Subject:	ENGR
Course Number:	15
Descriptive Title:	Engineering Graphics
Division:	Mathematical Sciences
Department:	Pre-Engineering
Course Disciplines:	Pre-Engineering
Catalog Description:	This course 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.
Prerequisite:	Math 170 with a minimum grade of C
Co-requisite:	None
Recommended Preparation:	
Enrollment Limitation:	35
Hours Lecture (per week):	2
Hours Laboratory (per week):	3
Outside Study Hours:	4
Total Course Hours:	90
Course Units:	3
Grading Method:	Letter Grade and Pass/No Pass
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	Fall 2024
Transfer UC:	Yes
Effective Date:	Fall 2024
General Education ECC:	
Term:	
Other:	
CSU GE:	
Term:	
Other:	
IGETC:	
Term:	

Other:	
Student Learning Outcomes:	**SLO #1 Orthographic Projections** Apply rules of orthographic projection to create multiview drawings. **SLO #2 Modeling** Use CAD software to create 2D and 3D engineering drawings. **SLO #3 Dimensioning and Tolerancing** Apply standards of dimensioning and tolerancing to engineering drawings.
Course Objectives:	1. Explain the engineering design process to a design project. 2. Use of drafting/sketching instruments: triangles, scale/ruler, compass, drawing templates. 3. Draw technical sketches. 4. Demonstrate through drawing, the use of line construction, and identify line-forms contained in the "alphabet" of technical linework. 5. Practice the use of computer aided drawing (CAD) tools. 6. Illustrate and discuss solid-object visualization techniques. 7. Sketch or draw graphic elements; e.g., planes, angles, surfaces. 8. Construct orthographic projection drawings. a. Multiview b. Auxiliary view c. Section view 9. Construct axonometric projection drawings. a. Isometric b. Oblique 10. Apply dimensions to engineering drawings with a basic knowledge of tolerances. 11. Describe the fundamental concepts of Geometric Dimensioning and Tolerancing (GD&T). 12. Define, explain, and label standard threaded fasteners. 13. Create engineering working-drawings used for fabrication and assembly. 14. Use Computer Aided Drawing (CAD) software to create 2D engineering drawings, including working drawings and assembly drawings. 15. Use Computer Aided Drawing (CAD) software to construct 3-Dimensional (3D) drawing-models. a. Surface Models b. Solid Models 16. Generate using descriptive geometry techniques spatial relationships. a. The point view of a line b. The true length of a line c. The edge view of a plane d. The true size of a plane
Major Topics:	**I. Introduction (2 hours, lecture)** A. Definition of engineering graphics B. Engineering drawing types

C. Visualization skills

II. Introduction (1 hour, lab)

A. Use of CAD tools in definition of engineering graphics

B. Use of CAD tools in engineering drawing types

C. Use of CAD tools in visualization skills

III. Lettering and Review of Geometric Construction (2 hours, lecture)

A. Lettering fonts

B. Geometric construction practice

C. Bisecting lines and arcs

D. Circles and curves

E. Tangencies

IV. Lettering and Review of Geometric Construction (3 hours, lab)

A. Use of CAD tools in lettering fonts

B. Use of CAD tools in geometric construction practice

C. Use of CAD tools in bisecting lines and arcs

D. Use of CAD tools in circles and curves

E. Use of CAD tools in tangencies

V. Measurement Tools (3 hours, lecture)

A. Engineering Scales

B. Architecture Scales

C. Calipers and micrometers

D. CAD software measurement tools for distance, mass and density

VI. Measurement Tools (4 hours, lab)

A. Use of CAD tools in engineering scales

B. Use of CAD tools in architecture scales

C. Use of CAD tools in calipers and micrometers

D. CAD software measurement tools for distance, mass and density

VII. Orthographic Projection (4 hours, lecture)

A. Glass Box concept

B. Vocabulary of drawing concepts

C. Visualization of 3D objects

D. Third angle and first angle projection

E. 2D CAD software for orthographic projection

F. Using layers in AutoCAD for line types

G. Multiview drawings by hand and in CAD software

H. 2D and 3D construction and editing tools

VIII. Orthographic Projection (8 hours, lab)

A. Use of CAD tools in Glass Box concept

B. Use of CAD tools in vocabulary of drawing concepts

C. Use of CAD tools in visualization of 3D objects

D. Use of CAD tools in third angle and first angle projection

E. 2D CAD software for orthographic projection

F. Using layers in AutoCAD for line types

G. Multiview drawings by hand and in CAD software

H. 2D and 3D construction and editing tools

IX. Pictorials (4 hours, lecture)

A. Visualization of 3D objects

B. Axonometric projection

C. Isometric views

D. Dimetric views

E. Trimetric views

F. Oblique projection

G. Perspective view

H. Selecting views in CAD

X. Pictorials (6 hours, lab)

A. Use of CAD tools in visualization of 3D objects

B. Use of CAD tools in axonometric projection

C. Use of CAD tools in isometric views

D. Use of CAD tools in dimetric views

E. Use of CAD tools in trimetric views

F. Use of CAD tools in oblique projection

G. Use of CAD tools in perspective view

H. Use of CAD tools in selecting views in CAD

XI. Auxiliary Views (4 hours, lecture)

A. Determining the need for an auxiliary view

B. Descriptive geometry

C. True size and shape

D. Creating auxiliary views in CAD

XII. Auxiliary Views (6 hours, lab)

A. Use of CAD tools in determining the need for an auxiliary view

B. Use of CAD tools in descriptive geometry

C. Use of CAD tools in true size and shape

D. Creating auxiliary views in CAD

XIII. Section Views (4 hours, lecture)

A. Types of sections

B. Full and half sections

C. Revolved sections

D. Fasteners and standard notation of threaded fasteners

E. Cutting planes

XIV. Section Views (6 hours, lab)

A. Use of CAD tools in types of sections

B. Use of CAD tools in full and half sections

C. Use of CAD tools in revolved sections

D. Use of CAD tools in fasteners and standard notation of threaded fasteners

E. Use of CAD tools in cutting planes

XV. Dimensioning and Tolerancing (3 hours, lecture)

A. Coordinate dimensioning and tolerancing

B. Arrow heads, callouts, leader lines

C. Placement of dimensions

D. Dimensioning and tolerancing in CAD

E. Design judgement for complete dimensioning and tolerance selection

XVI. Dimensioning and Tolerancing (6 hours, lab)

A. Use of CAD tools in coordinate dimensioning and tolerancing

B. Use of CAD tools in arrow heads, callouts, leader lines

C. Use of CAD tools in placement of dimensions

D. Use of CAD tools in dimensioning and tolerancing in CAD

E. Use of CAD tools in design judgement for complete dimensioning and tolerance selection

XVII. Geometric Dimensioning and Tolerancing (3 hours, lecture)

A. Feature control frames

B. Maximum and least material condition

C. Using engineering or design judgement to determine tolerance

D. Manufacturability and cost and quality considerations

E. Working with technicians and technologists for efficient designs

XVIII. Geometric Dimensioning and Tolerancing (6 hours, lab)

A. Use of CAD tools in feature control frames

B. Use of CAD tools in maximum and least material condition

C. Using engineering or design judgement to determine tolerance with CAD tools

D. Use of CAD tools in manufacturability and cost and quality considerations

E. Use of CAD tools in working with technicians and technologists for efficient designs

XIX. Types of Drawings (3 hours, lecture)

A. Detail, shop and assembly drawings

B. Production drawings

C. Assembly drawings in CAD

D. Exploded views

E. 3D project modeling, building information management (BIM)

F. File maintenance and conversion

G. Electronic documentation of large engineering projects

XX. Types of Drawings (4 hours, lab)

A. Use of CAD tools in detail, shop and assembly drawings

B. Use of CAD tools in production drawings

C. Use of CAD tools in assembly drawings in CAD

D. Use of CAD tools in exploded views

E. Use of CAD tools in 3D project modeling, building information management (BIM)

F. Use of CAD tools in file maintenance and conversion

G. Use of CAD tools in electronic documentation of large engineering projects

XXI. Engineering Design process (4 hours, lecture)

A. Steps in the engineering design process

	B. Design, prototyping and iteration C. Efficiency in CAD design **XXII. Engineering Design process (4 hours, lab)** **A.** Use of CAD tools in steps in the engineering design process B. Use of CAD tools in design, prototyping and iteration C. Efficiency in CAD design
Total Lecture Hours:	36
Total Laboratory Hours:	54
Total Hours:	90
Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	Draw the front, top, and side orthographic views of the object shown based on the partially complete isometric drawings, based on the following picture.
Critical Thinking Assignment 1:	Measure and redraw the shape shown. Add the appropriate dimensions. Specify the units and scale of the drawing. The dotted grid background has 0.5 inch spacing, see the picture below.
Critical Thinking Assignment 2:	Draw the object as follows (dimension shown are in inches), based on the following figure: a. Draw as a solid model b. Create front, top and right-side orthographic views from the solid model. c. Dimension the orthographic views
Other Evaluation Methods:	Essay Exams, Homework Problems, Laboratory Reports
If Other:	
Instructional Methods:	Group Activities
If other:	
Work Outside of Class:	Problem solving activity, Required reading, Study
If Other:	
Up-To-Date Representative Textbooks:	David Byrnes, James D. Bethune. Engineering Graphics with AutoCAD 2023. Pearson, 2023, ISBN-13 9780137929993.
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	

Requisite	Prerequisite
Category	
Requisite course:	MATH 170
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	**Since orthographic projections require geometry, students should be able to demonstrate trigonometric symbols, understand six basic trigonometric functions and be able to select appropriate trigonometric identity for solving trigonometric equations.** MATH 170 - Use the law of sines and law of cosines to solve oblique triangles.
Requisite Skill:	
Requisite Skill and Matching skill(s): Bold the requisite skill(s). if applicable	
Requisite course:	
Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). if applicable	
Enrollment Limitations and Category:	Enrollment for this course will be 35 students per section, with the option for the professor up to no more than 40 students.
Enrollment Limitations Impact:	Exceeding the enrollment aforementioned will affect the quality of instructor-to-student interaction. Furthermore, there may not be enough course equipment for all students to use. This creates an equity issue.
Course Created by:	Pavan Nagpal
Date:	10/27/2022
Original Board Approval Date:	07/17/2023 effective FALL 2024