ENGR M04: ENGINEERING DESIGN/CAD

Originator
srelle

College
Moorpark College

Discipline (CB01A)
ENGR - Engineering

Course Number (CB01B)
M04

Course Title (CB02)
Engineering Design/CAD

Banner/Short Title
Engineering Design/CAD

Credit Type
Credit

Start Term
Spring 2020

Catalog Course Description
Develops engineering drawing skills through manual and computer-aided drafting (CAD) in two- and three-dimensions. Improves three-dimensional spatial visualization skills. Utilizes principles of orthographic drawing, pictorial drawing, and descriptive geometry. Covers principles of orthographic projections; graphical presentation of normal, inclined, and oblique surfaces; auxiliary and sectional views; dimensioning; and tolerances. Builds an understanding for the engineering problem solving and design process through design projects.

Additional Catalog Notes
UC Credit Limitations: ENGR M04, DRFT M02A, and DRFT M02B combined: maximum credit, one course.

Taxonomy of Programs (TOP) Code (CB03)
0924.00 - *Engineering Technology, General (requires Trigonometry)

Course Credit Status (CB04)
D (Credit - Degree Applicable)

Course Transfer Status (CB05) (select one only)
A (Transferable to both UC and CSU)

Course Basic Skills Status (CB08)
N - The Course is Not a Basic Skills Course

SAM Priority Code (CB09)
C - Clearly Occupational

Course Cooperative Work Experience Education Status (CB10)
N - Is Not Part of a Cooperative Work Experience Education Program

Course Classification Status (CB11)
Y - Credit Course

Educational Assistance Class Instruction (Approved Special Class) (CB13)
N - The Course is Not an Approved Special Class

Course Prior to Transfer Level (CB21)
Y - Not Applicable

Course Noncredit Category (CB22)
Y - Credit Course

Funding Agency Category (CB23)
Y - Not Applicable (Funding Not Used)

Course Program Status (CB24)
1 - Program Applicable

General Education Status (CB25)
Y - Not Applicable

Support Course Status (CB26)
N - Course is not a support course

Field trips
May be required

Faculty notes on field trips; include possible destinations or other pertinent information
Engineering and manufacturing firms where computer aided engineering design is an essential part of their operations.

Grading method
Letter Graded

Alternate grading methods
Student Option- Letter/Pass
Pass/No Pass Grading

Does this course require an instructional materials fee?
No

Repeatable for Credit
No

Is this course part of a family?
No

Units and Hours

Carnegie Unit Override
No

In-Class

Lecture
Minimum Contact/In-Class Lecture Hours
35
Maximum Contact/In-Class Lecture Hours
35

Activity

Laboratory
Minimum Contact/In-Class Laboratory Hours
52.5
Maximum Contact/In-Class Laboratory Hours
52.5

Total in-Class

Total in-Class
Total Minimum Contact/In-Class Hours
87.5
Total Maximum Contact/In-Class Hours
87.5

Outside-of-Class

Internship/Cooperative Work Experience

Paid

Unpaid

Total Outside-of-Class

Total Outside-of-Class
Minimum Outside-of-Class Hours
70
Maximum Outside-of-Class Hours
70

Total Student Learning

Total Student Learning
Total Minimum Student Learning Hours
157.5
Total Maximum Student Learning Hours
157.5

Minimum Units (CB07)
3
Maximum Units (CB06)
3

Prerequisites
MATH M06 - Trigonometry or MATH M07 - Trigonometry and Pre-Calculus

Entrance Skills

Prerequisite Course Objectives
MATH M06-identify special triangles and their related angle and side measures.
MATH M06-evaluate the trigonometric function of an angle in degree and radian measure.
MATH M06-convert between polar and rectangular coordinates and equations.
MATH M06-represent a vector (a quantity with magnitude and direction) in the form and ai+bj.
MATH M07-solve systems of equations and inequalities.
MATH M07-apply functions to model real world applications.
MATH M07-identify special triangles and their related angle and side measures.
MATH M07-evaluate the trigonometric function at an angle whose measure is given in degrees and radians.
MATH M07-convert between polar and rectangular coordinates.
MATH M07-represent a vector (a quantity with magnitude and direction) in the form and ai+bj, compute the magnitude of a vector, and graph vectors on the xy-plane.
MATH M07-perform vector operations including addition, subtraction, scalar multiplication, and dot product. Determine the angle between two vectors and when vectors are parallel or perpendicular, and compute the projection vector.
MATH M07-graph plane curves described by parametric equations.
MATH M07-find parametric forms for functions in the plane and eliminate the parameter given curves in parametric form.

Requisite Justification

Requisite Type
Prerequisite

Requisite
MATH M06

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Content review

Requisite Type
Prerequisite

Requisite
MATH M07

Requisite Description
Course not in a sequence

Level of Scrutiny/Justification
Content review

Student Learning Outcomes (CSLOs)

	Upon satisfactory completion of the course, students will be able to:
1	use computer aided drafting (CAD) software to generate two- and three-dimensional engineering drawings following standard drawing conventions recognized in the field of engineering.
2	apply acquired CAD skills to develop a product design using the engineering design process.
3	use CAD software to model an engineering product to convey its physical and mechanical attributes in terms of its shape, size, and function.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1	generate two- and three-dimensional engineering drawings using manual and computer-aided drafting (CAD) for an engineering product using standard drawing conventions recognized in the field of engineering.
2	demonstrate drawing skills and three-dimensional visualization skills by creating isometric, orthographic, auxiliary, and sectional views.
3	apply rules of dimensioning and tolerancing, in addition to standard conventions for symbols, styles, and terminology in engineering drawings.
4	apply the engineering design process to develop creative solutions to engineering problems through reliable independent work and effective teamwork.
5	convey the engineering design process through engineering drawing, modeling, technical writing, and oral presentation.

Course Content

Lecture/Course Content

1. **(25%) - Basic engineering drawing concepts**
   a. Manual sketching and scaling
   b. Drawing of surfaces - normal, inclined, oblique, cylindrical
   c. Types of engineering drawings
      i. Detailed and assembly drawings
      ii. Auxiliary and sectional views
      iii. Orthographic projections
      iv. Pictorial drawings - isometric and oblique

   d. Measurements, symbols, styles, layouts, and linetypes
   e. Threaded fastener terminology
   f. Printing the drawings
2. **(30%) - Computer-aided drafting (CAD) in two-dimensions**
   a. Essential drawing tools and aids in CAD
      i. Methods of command entry and editing tools
      ii. Tabs, palettes, tools, status bar
   b. Lines, circles, arcs, fillets, chamfers
   c. Layers, linetypes, templates, arrays
   d. Dimensions, tolerances, and polylines
3. **(45%) - Computer-aided drafting (CAD) in three-dimensions**
   a. Basics of solid modeling
   b. Geometry, features, and models
   c. Editing geometry, features, and models
   d. Creating sketcher geometry
   e. Using sketcher tools
   f. Creating sketches for features
   g. Creating extrudes, revolves, ribs, holes, shells, drafts, rounds, and chamfers

Laboratory or Activity Content

Students will be using the computer lab equipped with AutoCAD software and SolidWorks software to learn computer-aided drafting skills in two- and three-dimensions.

1. **(30%) - Computer-aided drafting (CAD) in two-dimensions**
   a. Exercises to enhance skills in using AutoCAD to create various engineering drawings
   b. Practice using the drawing techniques introduced in class
2. **(45%) - Computer-aided drafting (CAD) in three-dimensions**
   a. Exercises to enhance skills in using SolidWorks to create various solid models
   b. Practice using the modeling techniques introduced in class
3. **(15%) - Design projects using AutoCAD and SolidWorks**
4. **(10%) - Various engineering drawing exercises beyond the textbook to enhance computer drawing skills including, but not limited to, creating drawings for reverse engineering projects**
5. (Optional) Introduce the CREO software for three-dimensional solid modeling interspersed with SolidWorks

Methods of Evaluation

Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):

Skills demonstrations
Written expression

Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):

Classroom Discussion
Graphic/architectural designs
Group projects
Individual projects
Laboratory activities
Objective exams
Oral presentations
Projects
Participation
Quizzes
Reports/papers
Skills demonstrations
Skill tests

Instructional Methodology

Specify the methods of instruction that may be employed in this course

Audio-visual presentations
Computer-aided presentations
Collaborative group work
Class activities

Class discussions
Demonstrations
Field trips
Group discussions
Guest speakers
Instructor-guided interpretation and analysis
Instructor-guided use of technology
Laboratory activities
Lecture
Small group activities

Describe specific examples of the methods the instructor will use:

The instructor will use audio-visual presentations, class discussions, lectures, demonstrations, and computer-aided presentations to explain the various concepts of engineering drawings. Additionally, the instructor will demonstrate the use of each drawing software by projecting the software onto a screen and modeling its use.

Representative Course Assignments

Writing Assignments

1. Writing short answer homework or exam questions. A sample question could be to explain how the **Reference** option in CAD can be used to rotate a line from 60^{o} to 90^{o}, and how the same task could be accomplished without using the **Reference** option?

2. Writing a technical report on an engineering design project pertaining to either a particular product design or to a solution of an engineering problem.
A sample design project could be to design a device which would make a certain task possible for a physically challenged individual, and then document the design process, construction, and the expected outcome in a technical report.

Critical Thinking Assignments

1. Analyzing and synthesizing information presented in engineering drawings. A sample assignment would be for students to analyze various pictorial views and surfaces of an object, such as a paper airplane, and then construct the object using household material or material provided by the instructor.

2. Analyzing and synthesizing concepts in engineering design. An example would be to reverse engineer a mechanical toy or a device. Students would have to take the product apart, make measurements and drawings of its various parts, and then put the pieces correctly back together again for the product to operate properly.

Reading Assignments

1. Reading and critique an engineering drawing. If there are mistakes in the drawing, circle them, explain what the mistake is and how it should be corrected.

2. Reading a scientific or engineering peer reviewed journal articles in which engineering drawings were utilized to solve or analyze a problem, and then recreate that same drawing.

Skills Demonstrations

1. Use AutoCAD to create two dimensional engineering drawings.

2. Use SolidWorks to create three dimensional solid models of engineering designs.

Outside Assignments

Representative Outside Assignments

1. Research CAD-related websites for two- and three-dimensional drawings to learn about drawing tools, editing tools, and short-cuts in drawing that are not explicitly covered in class. An example would be: Create a single multi-colored line on a single drawing layer in AutoCAD.

2. Research topics on the Internet or in a library to successfully complete an assigned design project. A sample project would be to design a water supply system for a rural community in a developing nation. Students would need to research a rural community in a developing nation that has access to some form of fresh water, such as groundwater, and design a water distribution system for the needs of that rural community.

Articulation

C-ID Descriptor Number

ENGR 150

Status

Aligned

Equivalent Courses at 4 year institutions

University	Course ID	Course Title	Units
CSUN	MSE 248 & 248L	Engineering CAD and Graphics & Lab	2, 1
UCR	ME 9	Engineering Graphics and Design	4
UCSB	ME 10	Engineering Graphics: Sketching, CAD, and Conceptual Design	4
UCLA	MECH&AE 94	Introduction to Computer-Aided Design and Drafting	4
CSULB	MAE 172	Engineering Design Graphics	2

Comparable Courses within the VCCCD
ENGR V02 - Engineering Graphics & Design

District General Education

A. Natural Sciences

B. Social and Behavioral Sciences

C. Humanities

D. Language and Rationality

E. Health and Physical Education/Kinesiology

F. Ethnic Studies/Gender Studies

Course is CSU transferable
Yes

CSU Baccalaureate List effective term:
Fall 1995

CSU GE-Breadth

Area A: English Language Communication and Critical Thinking

Area B: Scientific Inquiry and Quantitative Reasoning

Area C: Arts and Humanities

Area D: Social Sciences

Area E: Lifelong Learning and Self-Development

CSU Graduation Requirement in U.S. History, Constitution and American Ideals:

UC TCA

UC TCA
Approved

IGETC

Area 1: English Communication

Area 2A: Mathematical Concepts & Quantitative Reasoning

Area 3: Arts and Humanities

Area 4: Social and Behavioral Sciences

Area 5: Physical and Biological Sciences

Area 6: Languages Other than English (LOTE)

Textbooks and Lab Manuals

Resource Type
Textbook

Classic Textbook
No

Description
Zeid, Ibrahim. *Mastering SolidWorks; The Design Approach.* 2nd ed., Peachpit, 2015.

Resource Type
Textbook

Classic Textbook
No

Description
Bethune, James. *Engineering Design Graphics with Solidworks.* Macromedia Press, 2019.

Resource Type
Textbook

Classic Textbook
No

Description
Dix, Mark, and Paul Riley. *Discovering AutoCAD 2017*. Peachpit, 2016.

Resource Type
Textbook

Classic Textbook
No

Description
Craig, Jerry W. *Engineering Graphics: Technical Sketching. Series 5*. Schroff Development Corporation (SDC), 2007.

Resource Type
Textbook

Classic Textbook
No

Description
Lombard, Matt. *Mastering SolidWorks*. Sybex, 2018.

Resource Type
Textbook

Classic Textbook
No

Description
Omura, George, and Brian C. Benton. *Mastering AutoCAD 2018 and AutoCAD LT 2018*. Sybex. 2018.

Library Resources

Assignments requiring library resources
Engineering design projects.

Sufficient Library Resources exist
Yes

Example of Assignments Requiring Library Resources
Research using the Library's print and online resources to find relevant information for the assigned design projects, such as product design, systems design, and reverse engineering projects.

Primary Minimum Qualification
ENGINEERING

Review and Approval Dates

Department Chair
10/11/2019

Dean
10/12/2019

Technical Review
10/17/2019

Curriculum Committee
11/5/2019

DTRW-I
MM/DD/YYYY

Curriculum Committee
MM/DD/YYYY

Board
MM/DD/YYYY

CCCCO
12/02/2019

Control Number
CCC000430448

DOE/accreditation approval date
MM/DD/YYYY