Lecture Contact Hours: 48-54; Homework Hours: 96-108; Total Student Learning Hours: 144-162
Laboratory Contact Hours: 48-54; Homework Hours: 0; Total Student Learning Hours: 48-54

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

ENGINEERING 100 – INTRODUCTION TO ENGINEERING AND DESIGN

3 hours lecture, 3 hours laboratory, 4 units

Catalog Description
Introduction to engineering as a way of perceiving the world. Overview of design and analytical techniques, problem solving and strategic thinking, disciplines, and ethics. Fundamentals of engineering graphics as a universal language and application to the visualization, representation, and documentation of designed artifacts, including orthographic projections, pictorial, section, and detail views; creation of basic to intermediate solid parts and assemblies; dimensioning and tolerancing practices; thread notation per ASME Y14.5M-1994. This course covers the principles of engineering drawings in visually communicating engineering designs, and an introduction to solid modeling and computer-aided design (CAD). Assignments develop technical sketching and 2D and 3D CAD skills. The use of solid modeling CAD software (SolidWorks and Creo Parametric) is an integral part of the course, as is the production of physical prototypes using 3D printing and other techniques. This course focuses on the design process and on spatial reasoning and visualization.

Prerequisite
None

Course Content
1) Role of the engineer in society as a critical thinker, innovator and problem solver
2) Nature of the problems solved and the types of thinking required by various engineering disciplines
3) Engineering problem solving: the engineering method for analysis of problems
4) Engineering problem solving: formal engineering design methods
5) Technical communication including laboratory, design, and analysis reports
6) Engineering ethics including codes of ethics and typical ethical problems faced by engineers
7) Use of engineering graphics as a universal language, and application to the visualization, representation, and documentation of designed artifacts including:
    a. Technical sketching: alphabet of lines, units and scales, geometric constructions, technical lettering
    b. Descriptive geometry and spatial reasoning
    c. Orthographic multi-view projections
    d. Pictorial drawings: isometric and oblique drawings
    e. Section views
    f. Auxiliary views
    g. Basic dimensioning and tolerancing standards
    h. Threaded fastener terminology per ASME Y14.5M-1994
    i. Detail and assembly drawings, bills of material
8) 3D solid modeling techniques including
    a. 2D CAD construction and editing
    b. Parametric modeling fundamentals
    c. Model assembly from part models
    d. Assembly modeling and mating
    e. Comparison between various approaches to solid modeling (SolidWorks and Creo Parametric)
9) Production of physical prototypes using 3D printing and other techniques

Course Objectives

Students will be able to:

1) Describe the role of the engineer in society as a critical thinker, innovator and problem solver. Differentiate among the various disciplines of engineering, describing typical projects done within each and the necessary academic preparation and reasons for each.
2) Apply engineering design methods and strategic thinking to solve problems in the development of new or improved products.
3) Apply engineering analytical skills and methods to solve real world problems including the application and conversion of units.
4) Use appropriate written and oral forms of technical communication to present, explain, and justify engineering design decisions.
5) List the basic ethical rules governing engineers and apply them in ethically murky situations.
6) Draw freehand technical sketches which demonstrate knowledge of basic engineering conventions including the American standard arrangement of views, the use of a title block, standard drawing sizes, basic line types, and proper dimensioning technique.
7) Apply techniques of descriptive geometry and spatial reasoning to represent three-dimensional objects in two dimensions. Translate single-view pictorials into multi-view orthographic drawings. Given two orthographic views, draw a third orthographic view and a single-view pictorial.
8) Given a real object, draw all necessary orthographic, pictorial, sectional, and auxiliary views. Include sufficient but not excessive dimensions.
9) Create an exploded assembly drawing with a bill of materials for all parts of the assembly.
10) Determine tolerances in an assembly.
11) Apply solid modeling techniques to create individual parts.
12) Apply solid modeling techniques to create an assembly.
13) Produce fully annotated engineering working drawings from a 3D solid model.
14) Produce a physical part from an engineering drawing and/or from a 3D solid model.

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

1) Student portfolio of drawing exercises, projects, and prototypes in which students demonstrate their skill and competency in technical sketching, the use and application of 3D solid modeling software, and the production of physical objects from drawings.
2) Classroom assessment tools which may include reading quizzes, concept quizzes, attention quizzes, muddiest point questions, and one-minute papers that measure students' ability to apply concepts just discussed in class. An example would be an in-class calculation of the cost of an object based on its volume, density, and cost per unit weight.
3) Homework. Question types include requiring calculations, comparative analysis, short answer questions, and essay questions. An example would be a study to determine the lowest cost part that would support a given weight.
4) Written and oral design reports that demonstrate students' ability to apply the various design techniques presented in class, and present the concepts to an appropriate audience, both orally and in writing. An example would be an oral presentation by a design team of four students of an artifact that will make bicycles more broadly attractive to Americans as a means for commuting.
5) Final examination. Question types include requiring calculations, comparative analysis, short answer questions, essay questions, and problems in descriptive geometry, spatial reasoning, and engineering graphics. An example would be an ethical dilemma in which students explain the various ethical principles involved and offer a practical ethical solution.

Special Materials Required of Student

Graph paper, isometric graph paper, mechanical pencil .9mm and leads (HB or B), white vinyl eraser, calculator, USB flash drive (2GB or larger)

Minimum Instructional Facilities
1) Computer lab with SolidWorks and Creo Parametric software
2) At least two 3D printers (preferably five)

Method of Instruction
1) Lecture and discussion
2) Lab demonstration and assignments
3) Guest speakers
4) Hand-out materials, projects

Out-of-Class Assignments
1) Weekly homework including reading and writing assignments
2) Group design project
3) Other design projects
4) Drawing portfolio

Texts and References
1) Required (representative examples):
   a. Madsen, David A., Madsen, David P. *Engineering Drawing & Design* 6th edition. Cengage Learning, 2017.
   b. Reyes, Alejandro *Beginner's Guide to SOLIDWORKS 2019 Level 1* Schroff Development Corporation, 2018.
   c. Shih, Randy H. *Parametric Modeling with Creo Parametric 6.0*. 1st edition. Schroff Development Corporation, 2019.
2) Supplemental (representative examples):
   a. Norman, *The Design of Everyday Things*. MIT Press, 2002.
   b. Salvadori, *Why Buildings Stand Up*. Norton, 2002.
   c. Kidder, *The Soul of a New Machine*. Little, Brown, 2002.

Exit Skills
Students having successfully completed this course exit with the following skills, competencies and/or knowledge:
1) Describe the role of the engineer in society as a critical thinker, innovator and problem solver. Differentiate among the various disciplines of engineering, describing typical projects done within each and the necessary academic preparation and reasons for each.
2) Apply engineering design methods and strategic thinking to solve problems in the development of new or improved products.
3) Apply engineering analytical skills and methods to solve real world problems including the application and conversion of units.
4) Use appropriate written and oral forms of technical communication to present, explain, and justify engineering design decisions.
5) List the basic ethical rules governing engineers and apply them in ethically murky situations.
6) Draw freehand technical sketches which demonstrate knowledge of basic engineering conventions including the American standard arrangement of views, the use of a title block, standard drawing sizes, basic line types, and proper dimensioning technique.
7) Apply techniques of descriptive geometry and spatial reasoning to represent three-dimensional objects in two dimensions. Translate single-view pictorials into multi-view orthographic drawings. Given two orthographic views, draw a third orthographic view and a single-view pictorial.
8) Given a real object, draw all necessary orthographic, pictorial, sectional, and auxiliary views. Include sufficient but not excessive dimensions.
9) Create an exploded assembly drawing with a bill of materials for all parts of the assembly.
10) Determine tolerances in an assembly.
11) Apply solid modeling techniques to create individual parts.

12) Apply solid modeling techniques to create an assembly.
13) Produce fully annotated engineering working drawings from a 3D solid model.
14) Produce a physical part from an engineering drawing and/or from a 3D solid model.

Student Learning Outcomes

Upon successful completion of this course, students will be able to:

1) Demonstrate basic application of engineering concepts in the engineering design process.
2) Apply solid modeling and freehand techniques to create fully annotated drawings of individual parts and assemblies.
3) Produce a physical part from an engineering drawing and/or from a 3D solid model.