University Of California, Berkeley
Department of Mechanical Engineering

Engineering 26: Three-Dimensional Modeling for Design (2 units)

Undergraduate Required Course

Syllabus

CATALOG DESCRIPTION:

Three-dimensional modeling for engineering design. This course will emphasize the use of CAD on computer workstations as a major graphical analysis and design tool. Students develop design skills, and practice applying these skills. A group design project is required. Hands-on creativity, teamwork, and effective communication are emphasized.

COURSE PREREQUISITES: None

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL:

Lieu, D.K., and Sorby, S.A., Visualization, Modeling, and Graphics for Engineering Design, Cengage Publishers, 2008.

COURSE OBJECTIVES:

Introduce computer-based solid, parametric, and assembly modeling as a tool for engineering design; enhance critical thinking and design skills; emphasize communication skills, both written and oral; develop teamwork skills; offer experience in hands-on, creative engineering projects; reinforce the societal context of engineering practice; develop early abilities in identifying, formulating, and solving engineering problems.

DESIRED COURSE OUTCOMES:

Upon completion of the course, students shall be able to operate 3-dimensional solid modeling software tools with a high degree of skill and confidence; specify dimensions for parts and assemblies such that they can be fabricated, and fit such that they function with the desired result; produce rapid-prototype models of parts and assemblies to demonstrate their desired functionality; understand the design of systems, components, and processes to meet desired needs within realistic constraints.

TOPICS COVERED:

Computer-based solid and assembly modeling; parametric and feature-based design; extraction of 2-dimensional drawings from 3-dimensional models; rapid prototyping; reading and creating engineering project and system drawings; dimensioning for design intent.

CLASS/LABORATORY SCHEDULE: One hour of lecture and 2 hours of laboratory per week

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT:

Students learn graphical analysis and design techniques using the hardware and 3-dimensional software tools used by engineers in the field. Economic, manufacturing, and fabrication issues are considered throughout the course as

they apply to the topics addressed. Students are introduced to the concept of working in a group through the semester-long design project. As part of this project, students are required to communicate orally and graphically, and make presentations to the class and instructors.

RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES:

- Weekly laboratory and homework assignments 20%
    - The homework assignment will be closely integrated with the computer labs. During the labs, students will start by doing step-by-step solid modeling tutorials to learn different functionality. Then they will be given problems where they will apply what they've learned to model new geometries, assemblies, and products. There will be a focus on learning how to build a solid model to capture design intent and meaningful dependencies for ease of subsequent editing. Students will also learn how to set up for a 3D-print build, and 3D-print a geometry they design themselves. Homework problems will cover the theory behind the software, such as constraints and Booleans, and additional modeling problems that build on skills acquired during lab.
- Semester project. 30%
    - Students will be assigned to project teams of approximately 5 students. Each team will choose a product or mechanism with about twice as many unique parts as there are students in the group. In the first phase, each person in the group will build a model of at least one part, with all the parts divided up among the group members. In the second phase, the group will make a virtual assembly from the individual parts to check fit and function. In the third phase, after confirming fit and function in the virtual model, and making an oral presenation to the GSIs, they will 3D-print the parts and assemble them. For phase four, they will make any design changes necessary before producing a complete set of working drawings for all of the parts and the assembly. Finally, in phase five, project groups will exchange drawing sets and part collections, assemble the other group's project based on the drawings, and then suggest improvements to the drawing clarity and the design specifications. Students will then make final oral presentations to the class, and turn in final project drawings documenting the final design.
- Midterm examination 20%
- Final examination 30%

SAMPLE OF WEEKLY AGENDA

Week	Topic
1	Introduction to 3-dimensional modeling
2	Parametric sketching and geometric constraints
3	Extrusions and rotations
4	Features and feature based design
5	Design intent
6	Reference geometry
7	Arrays
8	Rapid prototyping
9	Rapid prototyping
10	Lofts, blends, and sweeps
11	Associative constraints and design tables
12	Assembly modeling
13	Rapid prototyping
14	Extraction of drawings

PERSON(S) WHO PREPARED THIS DESCRIPTION

Dennis K. Lieu and Sara McMains
21 April 2014

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): 3 DIMEN MOD DES
TIE CODE: LABS
GRADING: Letter
SEMESTER OFFERED: Fall and Spring
COURSES THAT WILL RESTRICT CREDIT: Students who have taken E10 and E28 will not receive credit for this course.
INSTRUCTORS: Dennis K, Lieu, Sara McMains, Ken Youssefi
DURATION OF COURSE: 14 weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 6
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: None