University Of California, Berkeley
Department of Mechanical Engineering

Engineering 27: Introduction to Manufacturing and Tolerancing (2 units)

Undergraduate Required Course

Syllabus

CATALOG DESCRIPTION

Geometric dimensioning and tolerancing (GD&T), tolerance analysis for fabrication, fundamentals of manufacturing processes (metal cutting, welding, joining, casting, molding, and layered manufacturing).

COURSE PREREQUISITES

E25 or E28

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Chapter 16 of Lieu, D.K., and Sorby, S.A., Visualization, Modeling, and Graphics for Engineering Design, Cengage Publishers, 2008.

Kalpakjian, S., and Schmid, S.R., Manufacturing Processes for Engineering Material, 5th edition, Prentice Hall Publishers, 2008

COURSE OBJECTIVES

Enable a student to create and understand tolerances in engineering drawings; enhance critical thinking and design skills; emphasize communication skills, both written and oral; offer hands-on experience in manufacturing; develop abilities in identifying, formulating, and solving engineering problems; introduce students to the context of engineering practice.

DESIRED COURSE OUTCOMES

Upon completion of the course, students shall be able to fabricate basic parts in the machine shop; understand and communicate tolerance requirements in engineering drawings using industry standard GD&T; use metrology tools to evaluate if physical parts are within specified tolerances; demonstrate familiarity with manufacturing processes; and design parts that can be fabricated realistically and economically using these processes.

TOPICS COVERED

Geometric dimensioning and tolerancing (GD&T), tolerance analysis for fabrication, fundamentals of manufacturing processes (metal cutting, welding, joining, casting, molding, and layered manufacturing).

CLASS/LABORATORY SCHEDULE

One hour of lecture and 3 hours of laboratory per week

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

Students learn to communicate tolerance requirements in engineering drawings using industry standard GD&T used by engineers in the field. Graphical communication skills for engineering are developed.

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

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

- Homework assignments on a weekly basis
- Laboratory assignments on a weekly basis
    - Most homework assignments will have a significant laboratory component, with most of the work completed during the lab. Pre-lab exercises will include watching orientation and safety training videos for the machine tools, and answering questions based on the lectures that will prepare them for hands-on activities in the labs. In manufacturing labs, students will manufacture simple parts using a subset of the manufacturing processes covered. In tolerancing labs, students will learn about how to place datums, how to measure with respect to a coordinate system defined by a datum reference frame, how to interpret tolerance zones, the effect of choices of tolerance type and datum, and practice calculating fits and clearances.

- Semester project
    - Students will work in teams of approximately 5 people to develop tolerance specifications for components of an assembly. Then they will fabricate physical components in the machine shop from specifications provided by the instructors, some of which will be the specifications developed by other teams. In the third stage of the project, when components from different teams are assembled together and do not have the desired fits or functionality, the teams will revise their original tolerance specifications.

- Midterm examination
- Final examination

SAMPLE OF WEEKLY AGENDA

Intro to milling, drilling, turning
Intro to GD&T, planar datums, true position tolerancing
Maximum Material Condition tolerancing
Datum placement & MMC, cylindrical datums
Datum independent tolerances

Datum optional tolerances
Datum related tolerances
Virtual condition, functional gauges, Rule #1
Categories of fits, layered manufacturing
Introduction to CAD/CAM, Computer Numerical Control (CNC) machining
Tool paths, chip formation, cutting tools
Welding, riveting, mechanical fasteners
Casting and injection molding
Design for Manufacture and Assembly

Labs and field trips may include demos, some hands-on, of other processes chosen from:

- Electrical Discharge Machining (EDM)
- Forging
- Laser and water jet machining
- Rolling
- Extrusion, wire drawing
- Sheet metal forming
- Powder Metallurgy
- Grinding, finishing operations

PERSON(S) WHO PREPARED THIS DESCRIPTION

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April 11, 2014

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): INTRO MAN TOLERANCING
TIE CODE: LABS
GRADING: Letter
SEMESTER OFFERED: Fall and Spring
COURSES THAT WILL RESTRICT CREDIT: None.
INSTRUCTORS: McMains, Lieu, Dornfeld, Taylor
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