

AE 6380 - Fundamentals of Computer-aided Design and Engineering

Catalog Data: AE 6380: Fundamentals of Computer-aided Design and Engineering. Credit 3 (3-0-3). Introduction to the principles of geometric modeling; 2-D systems; 3-D wireframe, surface and solid representations; mathematical representations of curves, surfaces, solids; application to aerospace design problems.

Textbook: Rogers, D. F. and J. A. Adams, *Mathematical Elements for Computer Graphics*, 2nd ed., McGraw-Hill, 1990..

References: M.E. Mortenson, *Geometric Modeling*, John Wiley & Sons, 1985.I.D.

Faux and M.J. Pratt, *Computational Geometry for Design and Manufacture*, Halsted Press, 1979,

J.D. Foley and A. Van Dam, *Fundamentals of Interactive Computer Graphics*, Addison-Wesley.

Coordinator: J. I. Craig, Professor of A.E.

Goals: The course examines the area that is commonly referred to as CAD, CAED, or CAD/CAM. The general objectives of the course are described below. Also included is a more detailed course outline that provides a topic by topic list of the material to be covered. The objectives are:

- (a) to acquaint the student with some of the terminology in this field and relate it to the basic engineering process of design,
- (b) to provide an introduction to the analytical fundamentals that are used to create and manipulate geometric models in a computer program,
- (c) to introduce the student to commercial software systems designed for geometric modeling of engineering components and systems (attention will be directed at both drafting and 3-D modeling systems), and
- (d) to provide a survey of methods for integrating these tools into a comprehensive design system; topics include: parametric based CAD, feature-based CAD, and information systems.

Much of the material covering the subject area was first published in journal articles and is only now becoming available in textbook form. The lectures will be supplemented by material from recent textbooks and optionally by copies of related articles, etc.

Prerequisites by Topic:

1. Familiarity with a programming language (e.g., Matlab).
2. Advanced calculus and elementary ordinary differential equations.
3. Elementary linear algebra.
4. Basic principles of descriptive geometry.

Topics:

1. Introduction to CAD; review of basics of interactive computer graphics; hardware and software issues. (1 class)
2. Representation of simple geometric elements (points, lines). (2 classes)
3. Transformations, projections, view generation. (6 classes)
4. Design of 3-d curves; hermitian interpolation, Bezier curves, B-spline curves. (12 classes)
5. Design of surfaces; Coons patches; Bezier surfaces; general surface design processes. (9 classes)
6. Representation of solid models; b-rep models; csg models; introduction to topology of surfaces and solids. (9 classes)
7. Design system integration and database issues. (3 classes)

Computer Usage:

The course is divided into two basic sections, one dealing with the fundamentals and taught largely in the classroom, and the second dealing with applications and taught mainly through computer-based project assignments. Geometric modeling principles are demonstrated through programming assignments using Matlab. Extensive use is made of the commercial CAD and geometric modeling systems in the CAE/CAD Lab. The emphasis is on developing an understanding of the fundamentals behind these tools while at the same time building the necessary skill levels to effectively apply them to engineering problem-solving. A limited amount of traditional homework is assigned, collected and checked for completeness.

Laboratory Projects:

The major part of the grade is generated from 5 or 6 projects that are done on an individual basis. A final team project is included. All work is done on the computer systems available in the CAE/CAD Lab using accounts established for individual use. The facilities in the Lab are generally state-of-the-art and include the necessary commercial application software.

ABET category content as estimated by faculty member who prepared this course description:

Engineering Science:	1 credit or 33%
Engineering Design:	2 credits or 67%

Prepared by: J. I. Craig

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