

# **ECE 567-AME 567**

## **Computer Graphics and CAD**

**Purpose:** To prepare students for research in both the fundamentals and the applications of CAD/CAM, computer graphics, computer vision, and geometric modeling,.

**Prerequisites:** A knowledge of vector calculus, and one or more programming languages (e.g. the C language).

### **Contents**

1. Computational Geometry
  - Explicit Representations
  - Implicit Representations
  - Parametric Representations
  - Intersections
2. Data Structures for Computer Graphics
  - Linked lists
  - Arrays
  - Trees
  - Polyhedra
  - Object Databases
3. Transformations
  - 2D Transformations
  - 3D Object Transformations
  - Rotation
  - Translation
  - Scaling and Reflection
  - Composition of Transformations
  - 3D Coordinate Transformations
4. Viewing Computations
  - Homogeneous coordinates
  - Parallel and Multi-view Orthographic Projections
  - Perspective Projections
  - View Volumes
  - Clipping
5. Space Curves
  - Representing Curves for Computing
  - Computing Properties - Tangents, Normals, Curvature, Torsion, Bi-normal
  - Piece wise Parametric Cubic
  - Matrix approach
  - Ferguson and Bezier curve segments
  - Composite Curves
  - B-splines
6. Surfaces
  - Representing Surfaces for Computing
  - Computing Properties - Normals, Curvature, fundamental Matrices
  - primitive surfaces
  - Surfaces of Revolution
  - Linear Swept Surfaces

- Surface Patches
- Free-form surfaces - Parametric Cubic surfaces
- Composite Surfaces
- 7. Solid Modeling
  - Boundary Representation
  - Constructive Solid Geometry
  - Spatial Enumeration
  - Feature Modeling
  - Feature Extraction
  - STEP
- 8. Hidden Line and Hidden Surface Removal
  - Computing Visibility
  - Z-Buffer algorithms
- 9. Applications
  - Robotics: Automated Assembly, Path Planning, and Object Recognition,
  - Computer Aided Design, and Computer Aided Manufacturing,
  - Spatial Reasoning

### **Class Communications:**

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Class Email: [ece567@ece.arizona.edu](mailto:ece567@ece.arizona.edu)  
Class Website: <http://www-isl.ece.arizona.edu/~ece567>

### **Major Sources:**

1. "Computer Graphics with Open GL", Hearn and Baker, Prentice Hall, latest edition.
2. Class Notes and Articles from the Literature, Dr. Michael Marefat, Distributed periodically for duplication.

#### OTHER REFERENCE SOURCES:

- 1..“Geometric Modeling and computer graphics for engineers”, Vera Anand, Wiley Pub., latest edition.

### **Grading Policy:**

There will be one exam, and about 5 assignments (short projects). Assignments will include some programming.

Assignments (about 5)	50 %
Final Exam	50 %
TOTAL	100%

Note that all assignments may not have equal weights.