Application for New Course

1. Submitted by the College of Engineering         Date: August 1, 2000
Department/Division offering the course: Computer Science

2. Proposed designation and Bulletin description of this course:
   (a) Prefix & Number: CS 631
   (b) Full Title: Computer-Aided Geometric Design
   Abbreviated Title (≤ 24 characters): Comp-Aided Geom Dsgn
   (c) Lecture/Discussion hours per week: 3
   (d) Laboratory hours per week: 0
   (e) Studio hours per week: 0
   (f) Credits: 3
   (g) Course description:
   Overview of current concepts and issues in CAGD with emphasis on free-form surface design; mathematics of free-form curve and surface representations, including Coons patches, Gregory patches, Bezier method, B-splines, NURBS, triangular interpolants, and their geometric consequences; creating objects with smooth surfaces, covering assemblies of spline patches, geometric and parametric continuity, texture mapping onto complex shapes, subdivision surfaces, surface evolution, and global optimization.
   (h) Prerequisites (if any): CS-535 and CS 321, or consent of instructor.
   (i) May be repeated to a maximum of: Not applicable

3. To be cross listed as: Not applicable
   Signature of cross-listing chair: __________________________

4. Effective date: Fall 2001

5. Course to be offered: Fall Spring Summer

6. Will the course be offered annually; explain if not: Yes

7. Why is the course needed? Computer-aided geometric design is the technique to design/describe the shape of an object or to simulate dynamic processes. It is a primary ingredient in computer-aided design and computer-aided manufacturing (CAD/CAM) systems, computer graphics, computer art, animation, simulation, computer vision, and robotics. Advances in any of these areas depend on how well we can create effective geometric models.

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9. (a) By whom will the course be taught? Fuhua (Frank) Cheng
   (b) Are facilities for teaching this course now available? Yes
   If not, what plans have been made for providing them?
10. What enrollment may reasonably be expected? 15

11. Will this course serve students in the Department primarily? Yes
   Will it be of service to a significant number of students outside the Department? No
   If yes, under what area?

12. Check the category most applicable to this course:
   [X] traditional; offered in corresponding departments elsewhere;
   [ ] relatively new, now being widely established;
   [ ] not yet found in many (or any) other universities

13. Is this course part of a new proposed program? No
   If yes, which?

14. Will adding this course change the degree requirements in any programs? Yes
   If yes, explain:

15. Attach a list of the major teaching objectives of the proposed course and outline
   and/or a reference list to be used: See attached

16. If the course is a 100-200 level course, please submit evidence (e.g., correspondence)
   that the Community College System has been consulted.
   not applicable

17. Within the Department, who should be contacted for further information about the
   proposed course?
   Name: Fuhua (Frank) Cheng    Phone: 257-6760

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1Approval of this course will constitute approval of the program change unless other program modifications are proposed.
Signatures of Approval:

Department Chair: ___________________________ Date: 11/14/2003
Dean of the College: _________________________ Date: 2/8/01
Date of Notice to the Faculty: 1/26/01
Undergraduate Council\(^2\): ______________________ Date: ________
University Studies\(^2\): _______________________ Date: ________
Graduate Council\(^2\): ________________________ Date: ________
Senate Council\(^2\): _________________________ Date: ________
Date of Notice to the University Senate: ________

Action other than approval: ____________________________

\(^2\)If applicable, as provided by the Rules of the University Senate
**Needed Skills**
The students should be capable of programming in C++ or Java, and have a general understanding of 3D graphics, data structures, and numerical computing.

**Learning Objectives**
- An understanding of the main ideas in CAGD
- A geometric insight into curve and surface schemes
- The capability of designing large and numerically stable programs for applications in CAD/CAM.
- The capability to handle more advanced topics such as intersection, rendering, offset and constrained surface design problems.

**Topics**

**Techniques for the representation of smooth curves and surfaces:**
- Bezier curves and surfaces;
- Coons patches;
- Gregory patches;
- B-splines;
- Triangular interpolants;
- NURBS;
- Subdivision surfaces;
- Geometric continuity, G1, G2;
- Parametric continuity, C1, C2;

**Creating Objects with Smooth Surface**
- Blending techniques;
- Rectilinear axis design;
- Natural axis design;
- Interpolation and Interproximation techniques;
- Fairing techniques;
- Feature Generation;
- Constrained shape adjustment;
- Mesh Generation;
- Shape Sculpting;
- Surface evolution;
- Texture mapping onto complex shapes;
- Global optimization.
Grading
A student's grade will be determined by a weighted average of homework assignments, programming exercises, projects, midterm examinations, and the final examination. The faculty offering the course will make the details available at the start of the course.
A typical weighting is:

Homework and programs: 40%
Midterm Examinations (2 @ 15%): 30%
Final Examination: 30%

Possible Textbooks
Interactive Curves and Surfaces, (with Multimedia Tutorial on CAGD), A. Rockwood and P. Chambers, Morgan Kaufman Publishers, Inc.

NURB Curves and Surfaces,
Gerald Farin, A K Peters, Wellesley, MA.

An Introduction to Splines for Use in Computer Graphics & Geometric Modeling,