CURRICULUM PROPOSAL FORM

*DEADLINES:

PROPOSAL NUMBER: 99-

PROPOSAL TITLE: Computational Fluid Dynamics

SPONSOR/S: John E. Chen

DEPARTMENT: Mechanical Engineering

CHECK ALL THAT APPLY:

____ UNDERGRADUATE

____ GRADUATE

COLLEGE: Engineering

If LAS:

____ History/Humanities

____ Math/Sciences

____ Social/Behavioral Sciences

________________________

TYPE OF PROPOSAL. (Check ALL that Apply)

____ General Education

____ New Course in Bank

____ Existing course, Add To Bank

____ Multicultural/Global Designation

____ Writing Intensive Designation

____ New Minor/Concentration/Specialization

____ New Major/Degree Program

____ Short Term Course Proposal

____ New Course (NOT Gen. Ed.)

____ Name Change (Dept., School, Major)

____ Changes in Degree Requirements

____ Changes Involve Gen. Ed. requirements

____ Minor Changes to Existing Courses

____ Course is NOT General Education

____ Course IS General Education

DEPARTMENT

(SIGNATURE INDICATES APPROVAL)

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DEPT. CURRICULUM CHAIR / DATE

________________________

DEPT. CHAIRPERSON / DATE

COLLEGE CURRICULUM COMMITTEE

DATE OF OPEN HEARING (if necessary):

☑ APPROVED

— NOT APPROVED

COMMENTS:

________________________

SIGNATURE

DATE

ACADEMIC DEAN (& GRADUATE DEAN, for New Graduate Programs Only)

☑ APPROVED

— NOT APPROVED

COMMENTS:

________________________

SIGNATURE (Academic Dean)

DATE

SIGNATURE (Graduate Dean)

DATE
UNIVERSITY CURRICULUM COMMITTEE

DATE OF OPEN HEARING (if necessary): 2/14/99 (college level only)

APPROVED

NOT APPROVED

COMMENTS:

Signature: [Signature]
Date: 2/11/99

SENATE

Date announced at Senate: 2/8/99

Voted upon at Senate:

Approved
Not Approved
Date:

EXECUTIVE VICE PRESIDENT/PROVOST

APPROVED

NOT APPROVED If no, reasons are as follows:

STUDENT CREDIT HOURS
FACULTY LOAD HOURS
EQUALIZED CREDIT HOURS

OFFICIAL COPY & APPROVAL SHEET FILED (DATE): 

DATE/SIGNATURE EXECUTIVE VICE PRESIDENT/PROVOST:

REGISTRAR

DATE APPROVED COURSE DESCRIPTION RECEIVED:

HEGIS TAXONOMY & COURSE NUMBER ASSIGNED:

DATE/SIGNATURE OF REGISTRAR:

NOTIFICATION FORWARD:

\checkmark\ SENATE CURRICULUM COMMITTEE CHAIRPERSON

\checkmark\ DEPARTMENT CHAIRPERSONS

\checkmark\ ACADEMIC DEAN(S)

\checkmark\ REGISTRAR

SPONSOR(S)

curricul/currms.989/9899prop.wpd
Course Proposal

1. Details:
   a) **Course Title:** Computational Fluid Dynamics (0910.522)
   b) **Sponsor:** Dr. John C. Chen, Department of Mechanical Engineering, College of Engineering
   c) **Credit Hours:** 3 credit hours
   d) **Course Level:** Graduate
   e) **Curricular Effect:** A graduate elective for Masters of Science in Engineering majors. May also be taken by Chemical and Civil Engineering majors as a Technical Elective, if they meet the prerequisites.
   f) **Prerequisites:** Engineering Thermodynamics II (910.312) and Fluid Mechanics II (910.313), or equivalent courses.
   g) **Suggested Time/Scale of Implementation:** Fall 1999
   h) **Resources:** Faculty is in place to teach the course within the Department of Mechanical Engineering. Library resources are in place. Computer hardware resources are available in the Engineering Building to support this course. Software licenses are being purchased to support this course, and will be in place prior to the start of the course.

2. Rationale:

   The proposed course is part of the Engineering Curriculum Proposal approved by the University Senate in December 1994. The proposed course is consistent with the establishment of the College of Engineering approved by the Board of Trustees in February 1995. The curriculum for the Department of Mechanical Engineering consists of two major focuses: Mechanical Systems and Thermal/Energy Systems. Advanced Heat Transfer is an important elective for those wishing to focus on the thermal/energy systems track.

   The topics covered in this course extend the Fluid Mechanics course, required for all undergraduate mechanical, civil and chemical engineering students in most accredited programs. While undergraduate Fluid Mechanics provide an overview and introduction to the engineering fundamentals, Computational Fluid Dynamics will provide the students with powerful computational tools to solve problems that are ill suited for analytical solutions. Students successfully completing this course will be able to solve a wider range of fluid dynamics problems encountered in industry.
3. Essence of the Course:

a) Objectives:
Upon completion of this course, the graduate student will be able to

1. Apply finite difference, finite element, and finite volume methods for the numerical solution of fluid dynamic problems.
2. Derive the governing equations of fluid dynamics given the physical problem.
3. Apply principles of discretization to generate meshes and grids.
4. Apply CFD techniques to solve a range of practical problems, including incompressible, inviscid flow over simple geometries, one-dimensional nozzle flows, and two-dimensional supersonic flows.

b) Topical Outline:
The topical outline of the course is as follows, though some variation may exist due to the emphasis placed on each topic by different instructors. The topics to be covered will include the following:

Governing Equations of Fluid Dynamics
   Derivation
   Classification of partial differential equations

CFD Techniques
   Finite difference formulation
   Explicit methods
   Implicit methods

Stability and Efficiency Analysis

Discretization and Mesh Generation

Applications
   Parabolic equations
   Elliptic equations
   Hyperbolic equations
   Navier-Stokes Equations

Independent Project
   Review of journal publication
   CFD solution of reacting flow
c) Evaluation and Grading Procedure of Students:
Student grades will be determined on the basis of examinations, homework and/or projects, laboratory projects and reports.

d) Course Evaluation:
The proposed course will be evaluated on the basis of student evaluations and curriculum review by appropriate faculty.

4. Results of Consultations:
The proposed course is part of the Engineering Curriculum Proposal approved by the Faculty Senate in December 1994. Consultations were submitted with original proposal as specified by the Curriculum Committee. Additional curriculum consultations were performed with outside consultants including, Professor Skip Fletcher of Texas, A&M. Professor Fletcher is a fellow of the American Society of Mechanical Engineers.
Catalog Description:

Computational Fluid Dynamics (0910.522)
Prerequisites: Engineering Thermodynamics II (910.312) and Fluid Mechanics II (910.313), or equivalent.

This course serves as an overview of the techniques used to solve problems in fluid mechanics on computers and describes in detail those most often used in practice. Included are advanced techniques in computational fluid dynamics, like direct and large-eddy simulation of turbulence, multigrid methods, parallel computing, moving grids, structured, block-structured and unstructured boundary-fitted grids, free surface flows. The issues of numerical accuracy, estimation and reduction of numerical errors are treated in detail with many examples. An independent research project will be required on an advanced topic of mutual interest between the student and instructor.