

CURRICULUM PROPOSAL FORM

***DEADLINES:**

REGULAR COURSE PROPOSALS: OCTOBER 23, 1998 FOR FALL, 1999 AND FEBRUARY 19, 1999 FOR SPRING, 2000
SHORT-TERM COURSE PROPOSALS: DECEMBER 11, 1998 FOR FALL, 1999 AND MARCH 26, 1998 FOR SPRING 2000

PROPOSAL TITLE: Introduction to Computational Fluid Dynamics

SPONSOR/S: John C. Chen, Assistant Professor

DEPARTMENT: Mechanical Engineering

C910.422

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 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
- New Minor/Concentration/Specialization
- New Major/Degree Program
- Short Term Course Proposal

DEPARTMENT

(SIGNATURE INDICATES APPROVAL)

[Signature] 10/22/98

DEPT. CURRICULUM CHAIR / DATE

TR. Chaudhry 10/22/98

DEPT. CHAIRPERSON / DATE

COLLEGE CURRICULUM COMMITTEE

DATE OF OPEN HEARING (if necessary) _____

APPROVED

NOT APPROVED

COMMENTS:

[Signature] 2/10/99
SIGNATURE DATE

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

APPROVED

NOT APPROVED

COMMENTS:

[Signature] 10/23/98
SIGNATURE (Academic Dean) DATE

SIGNATURE (Graduate Dean) DATE

UNIVERSITY CURRICULUM COMMITTEE

DATE OF OPEN HEARING (if necessary): 2/10/99 (College level only)

APPROVED

NOT APPROVED

COMMENTS:

James M. Rees 4/1/99
SIGNATURE DATE

SENATE

Date announced at Senate 2/23/99

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 [Signature]

REGISTRAR

DATE APPROVED COURSE DESCRIPTION RECEIVED _____

HEGIS TAXONOMY & COURSE NUMBER ASSIGNED 0910:422

DATE/SIGNATURE OF REGISTRAR Robert A. LeBot 4/19/99

NOTIFICATION FORWARD:

- SENATE CURRICULUM COMMITTEE CHAIRPERSON
- DEPARTMENT CHAIRPERSONS
- ACADEMIC DEAN(S)
- REGISTRAR

T.M. 4/22/99

SPONSOR(S)

Course Proposal

1. Details:

- a) Course Title:** Introduction to Computational Fluid Dynamics (0910.422)
- b) Sponsor:** Dr. John C. Chen, Department of Mechanical Engineering, College of Engineering
- c) Credit Hours:** 3 credit hours
- d) Course Level:** Senior
- e) Curricular Effect:** A senior elective for Mechanical 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
One section
- 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. While Fluid Mechanics I and II provide an overview and introduction to the engineering fundamentals, Introduction to 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 undergraduate 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

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:

Introduction to Computational Fluid Dynamics (0910.422)

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.