

STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK



COURSE OUTLINE

MECH 416 - APPLIED COMPUTATIONAL FLUID DYNAMICS

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CANINO SCHOOL OF ENGINEERING TECHNOLOGY
ENGINEERING SCIENCE
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MECH 416 - APPLIED COMPUTATIONAL FLUID DYNAMICS

A. TITLE: Applied Computational Fluid Dynamics

B. COURSE NUMBER: MECH 416

C. CREDIT HOURS: 3

D. WRITING INTENSIVE COURSE: NA

E. COURSE LENGTH: 15

F. SEMESTER(S) OFFERED: Fall/Spring

G. HOURS OF LECTURE, LABORATORY, RECITATION, TUTORIAL, ACTIVITY: (2) 1 hour lectures, 2 hour lab

H. CATALOG DESCRIPTION:

This course introduces the student to modeling and analyzing fluid mechanics problems via the finite difference and finite volume method. Fundamentals of CFD theory, solution, procedures, techniques, and analysis are discussed. Topics include computational grid generation, fluid model setup, convergence and accuracy analysis, data interpretation, model validation and discussion of conclusions. Students will use CFD software to solve various fluid problems.

I. PRE-REQUISITES/CO-COURSES: Pre-requisite: MECH 341 - Intermediate Fluid Mechanics, MATH 262 Differential Equations

J. GOALS (STUDENT LEARNING OBJECTIVES):

By the end of this course, the students will be able to:

1. Define fluid application domain and create geometric model.
2. Create computational mesh
3. Assess fluid properties and boundary conditions
4. Evaluate appropriate fluid model to simulate the fluid applications.
5. Carry out the solution procedures and address convergence, stability, and accuracy analysis.
6. Collect and analyze CFD data.
7. Perform model validation.

K. TEXTS: Computational Fluid Dynamics: a Practical Approach, Jiyuan Tu, Guan Heng YEOH & Chaogun Liu, (Butterworth-Heinemann) current edition

L. REFERENCES: Fluid Mechanics, F.M. White, McGraw-Hill Book current edition

M. EQUIPMENT: Computer Lab

N. GRADING METHOD: A - F

O. EVALUATION CRITERIA/METHODS:

Exams, lab projects, quizzes, final project

P. DETAILED TOPICAL OUTLINE: See attached sheet

Q. LABORATORY OUTLINE: See attached sheet

DETAILED OUTLINE

MECH 416 - APPLIED COMPUTATIONAL FLUID DYNAMICS

- I. Introduction to Computational Fluid Dynamics
 - A. What is CFD
 - B. Advantage of CFD
 - C. Application of CFD
 - D. Future of CFD

- II. CFD Solution Procedures
 - A. Introduction
 - B. Problem Setup
 - C. Computational Grid Generation
 - D. Fluid Model Construction
 - E. Fluid Properties and Boundary Conditions
 - F. CFD Solver Processes
 - G. Result Report and Visualization

- III. Governing Equations for CFD
 - A. Introduction
 - B. Continuity Equation
 - C. Momentum Equation
 - D. Energy Equation
 - E. Application Specific Equations
 - F. Generic Form of the Governing Equations for CFD
 - F. Physical Boundary Condition for Governing Equations

- IV. CFD Techniques
 - A. Introduction
 - B. Discretization of Governing Equations
 - C. Finite-Difference Method
 - D. Finite-Volume Method
 - E. Converting Governing Equations to Algebraic Equations
 - F. Numerical Solution to Algebraic Equations

- V. CFD Solution Analysis
 - A. Introduction
 - B. Consistency Analysis
 - B. Stability Analysis
 - C. Convergence Analysis
 - D. Accuracy Analysis
 - E. Computing Efficiency

MECH 416 - APPLIED COMPUTATIONAL FLUID DYNAMICS

- I. Introduction to CFD and Software Package FLUENT
- II. 2D Channel Flow
- III. 3D Indoor Air Distribution
- IV. Indoor Air Distribution - Air Diffuser
- V. Indoor Air Quality - Pollution Dispersion
- VI. Heat Transfer Coupled with Fluid Flow
- VII. HVAC Simulation