Computational Fluid Dynamics
(ME EN 6720) Spring 2016

Instructor: Marc Calaf, Ph.D
(Office: MEK 2547)
Credit hours: 3 credit
Lecture: T, Th from 10:45 to 12:05
Room: WEB L114
Canvas Link: https://utah.instructure.com/courses/366444

Office hours: My office is always open to students. I encourage students to stop by and ask questions. In case I am not available the best option is to send me an email and fix a meeting time.

Reference Books:
Computational Methods for Fluid Dynamics (3rd Edition)
J.H. Ferziger and M. Perić (Springer, 2002)
Computational Fluid Dynamics: The Basics with Applications.
J. D. Anderson Jr. (McGraw-Hill, 1995)
Computational Fluid Mechanics and Heat Transfer 2nd Ed.
R. Pletcher, D. Anderson and J. Tannehill (Taylor and Francis, 1997)
Spectral Methods in Fluid Dynamics (Springer-Verlag, 1987)
Canuto, Hussaini, Quarteroni, and Zang.

Prerequisites: ME EN 2450, 3700 (CH EN 2450, 3353) or equivalent.

Course Description

This course covers topics related to Computational Fluid Dynamics (CFD). CFD is an important tool in engineering analysis and design of fluid systems. In this course we will develop the equations describing fluid flow and numerical solutions to these equations. Emphasis will be placed on understanding different approaches employed for both time and spatial discretization and how to evaluate these approaches. We will look at time accurate and steady-state methods, explicit and implicit techniques, laminar and turbulent flow, compressible and incompressible approaches, stability considerations, etc. These techniques will be applied to applications of mixing and heat transfer.

Math Requirements:

Vector analysis including partial differential equation. Solution to matrix equations including numerical methods. Solutions of nonlinear systems of equations.

Course Objectives:

- Describe the physical significance of each term in the governing equations for CFD.
- Develop finite difference and finite volume forms of the CFD equations and important model systems.
- Formulate explicit and implicit algorithms for solving the Navier-Stokes equations.
- Construct computer code to solve the Navier-Stokes equations in 2D.
- Understand and apply verification strategies for evaluating CFD code.
- Become familiar with commercial CFD package to solve practical CFD problems.
- Quantify and analyze the numerical error in CFD discretization schemes.

Grading:

Grades will be based on homework assignments and two class projects. Five homework assignments will be given during the semester. You will be given approximately 2 weeks to complete each assignment with time adjusted depending on the difficulty level of the assignments. Two class projects will be assigned. The first project will be uniform for everyone in the class and will require each student to solve the 2-D incompressible Navier-Stokes equations with different methods for a set problem. The second final project will be based on the individual CFD interests of each student. The project topics will need to be approved by the instructor approximately 1 month before the end of the semester when the final projects will be due. The results of both projects will be submitted in the form of short journal articles. Additionally, the main findings of the final project will be presented orally to the class during the last week of the semester.

- Homework: 50%
- Project 1: 20%
- Project 2: 30%

Late Policy:

Late submission of any assignment including homework, laboratory memos, and laboratory reports is not permitted. If a student anticipates a problem with the schedule, then he/she needs to make arrangements to submit the assignments EARLIER (not later). Electronic copies of the homework will be due in CANVAS by 5pm on the date due. Failure to follow this policy will result in a zero grade for the homework assignment, lab assignment or report.

Useful Information:

- **Accommodations Policy (pdf)**
- **Student Code of Conduct**
- **College of Engineering Student Guidelines**
- **Mechanical Engineering Advising Guide (pdf)**

Resources:

Writing Guidelines for Engineering and Science Students