# Computational Fluid Dynamic I

## *Department of Mechanical Eng., Shahrood Univ. of Technology*

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**Prerequisites** Mathematics, Programming.

**Topics Covered**

1. Basic Concepts
2. Conservation Laws of Fluid Mechanic
3. Finite Volume method for Diffusion Problem
4. Finite Volume method for Convection Problem
5. High Order Methods
6. Pressure-Velocity Coupling
7. SIMPLE and SIMPLER algorithms
8. Source Term in CFD
9. Implementation of Boundary Condition
10. Finite Volume method for Unsteady Problems
11. Solver Technology
12. Algebric Grid Generation
13. Stretching in Grid Generation
14. T.F.I. Grid Generation
15. Grid Control (if Time)
16. Differential Grid Generation (If Time)
17. Simple Multi Grid Method
18. V-Type Multi Grid Programming

**Main Projects**

Project 1: ‘’Channel Flow’’ or ‘’Lid-Driven Cavity Flow’’ using Finite Volume Method.

Project 2: Algebric Grid Generation.

Project 3: T.F.I. Grid Generation.

Project 4: V-Type Multi Grid.

The main purpose of this course is to help students develop a mastery of the underlying principles and the ability to solve, quickly and efficiently, a variety of real fluid mechanics problems. The lectures present and illustrate the fundamental laws and the methods and modeling approximations that form the basis of CFD.

**Textbooks**

1- ***An Introduction to Computational Fluid Dynamics***: The Finite Volume Method, H. Versteeg , W. Malalasekera.

2- ***Computational Methods for Fluid Dynamics***, Joel H. Ferziger, Milovan Peric.

3- ***Computational Techniques for Fluid Dynamics***, Clive A.J. Fletcher.

4- ***Numerical Heat Transfer and Fluid Flow***, Suhas Patankar.

5- ***Numerical Computation of Internal and External Flows***, Charles Hirsch.

6- ***Numerical grid generation Foundations and applications***, Joe F. Thompson.

**Homework Problems**

Homework problems are indicated in the course outline for each topic. It is necessary for all students to solve and turn in the homework problems.

**Examinations**

There will be 1- midterm exams during the term, announced well in advance. There will be a three-hour final exam. Quizzes and the exam will permit a limited number of pages of **open notes** (and a calculator and a book of mathematical formulas and tables). No other books will be allowed. The quizzes and the exam will not present you with routine problems, but will probe for mastery of the underlying material and for skill in modeling problems in the simplest possible realistic terms.

**Grading**

| **Activities** | **Percentages** |
|---|---|
| Mid Term | 15 % |
| Project 1 | 20 % |
| Project 2 | 10 % |
| Project 3 | 15 % |
| Project 4 | 15 % |
| Homework | 10 % |
| Final Exam | 15 % |
| Seminar | Extra Point (May be) |