Course Syllabus

Degree Program:

ME -Mechanical Engineering
■General Courses for Both ECE & ME Degree Programs

Course Name: Computational fluid dynamics (VM523)
Term offered: Fall 2017-2018 (3 credits)
Course Category: □ Required ■ Elective

Textbook: Essential computational fluid dynamics,
by O. Zikanov, John Wiley & Sons, Inc. (2010)
References:
1. Numerical Computation of Internal and External Flows: Computational methods for inviscid and viscous flows, by Charles Hirsch
2. Computational Techniques for Fluid Dynamics, by Clive Fletcher
3. Numerical Methods for Conservation Laws, by Randall LeVeque

Instructor(s): (Email, office hours and office room No. should be included)
Lipo Wang, lipo.wang@sjtu.edu.cn Room 209
Office hours: working time

Course Pre/Co-requisites: fluid mechanics

Grading Policy:
- 15% from homework (with some bonus problems)
- ~20% from one exam
- ~65% from programming projects (commercial software not allowed)
- Relative grading

Course description and scheduled teaching contents

Chap. 1.Introduction
Chap. II Governing Equations in fluid dynamics
Reynolds transport theorem, conservation laws, equation derivation
Chap. III Partial difference equations
General properties of the 1st order PDE: characteristic

2nd order PDF: characteristics, classification of PDE (hyperbolic, elliptic and parabolic), compatibility of boundary conditions and the different types of PDE
Chap. IV Discretization / Integration Fundamentals
Finite volume method, Finite difference method
Chap. V Numerical stability
Lax equivalence theorem, stability analysis
Chap. VI Numerical solution of some simple equations (Euler etc.)
Upwind methods, Upwinding for a scalar equation, explicit time-stepping methods
Chap VII Numerical solution of the (incompressible) Navier-Stokes equations
Projection method, boundary conditions
(Topic discussion: artificial compressibility, direct numerical simulation etc.)

Course objectives

1. To understand the principal concepts.
2. To apply the relevant knowledge to simulate basic scalar and fluid mechanics problems.

Academic Integrity: (Any types of honor code regulations like class rules, homework policy, exam rules or project collaboration policy could be defined here) It is very necessary to show up in the class. Homework assignments need to finish independently and submit on time. Frequent discussions and exchanges with the instructor are strongly encouraged. Any honor code violation behavior must be recorded with the corresponding penalty.

Academic integrity and Honor code policy: (Any types of honor code regulations like class rules, homework policy, exam rules or project collaboration policy could be defined here)
It is very necessary to show up in the class. Homework assignments need to finish independently and submit on time. Frequent discussions and exchanges with the instructor are strongly encouraged. To make a fair judgment of learning, strict rules related to homework assignments and exams need to be formulated without exception. Any honor code violation behavior (e.g. plagiarism) must be recorded with corresponding penalty. To follow the Honor Code policy, coding projects are not allowed to discuss and exchange with others. Of course, during exams, no communication of any kind (verbal or written) is allowed!