CEG9700 Numerical Methods and Simulations in Fluid Flows

Description: This course is designed for students who seek to understand fundamental principles for numerical simulation and modeling of fluids as well as to become competent in operating commercial software for practical problems. It teaches basic concepts, numerical methods, and applications in solving partial differential equations arising from fluid flow problems. The course covers potential flow equation, convection equations, diffusion equations, and Navier-Stokes equations; numerical discretization and related concepts; basic numerical methods for different types of equations; programming to solve a model problem; and practicing FLUENT to simulate flows. The course will be delivered via theoretical analysis and hands-on computer lab approaches.

Prerequisites: CE350, CE3350, Math391, and CE H1000. Or ask for permission of instructor

Textbook: C. A. J. Fletcher, Computational Techniques for Fluid Dynamics, Vol. 1: Fundamental and General Techniques, 2nd ed, Springer, 1996

References: 1) H. Lomax, Thomas H. Pulliam, David W. Zingg, Fundamentals of Computational Fluid Dynamics, 2nd ed, Springer, 2004
2) Gary A. Sod, Numerical Methods in Fluid Dynamics: Initial and Initial Boundary-Value Problems, Cambridge University Press, 1985

Time and location: W, 6:50 – 9:20 pm, MR-408
Instructor: Prof. Hansong Tang
Office hours: M, W, 3:00-5:00 pm
Office: Steinman Hall-CCNY, T-122, Tel: 212-650-8006
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Time Tables:

Week	***Topic***
1.	Introduction: examples, history, and current status
1-2	Typical flow related equations: classification, properties, and initial/boundary conditions
3.	Numerical discretization: approximation, mesh generation
4.	Concepts: accuracy, consistency, stability, convergence, and Lax equivalent theorem
5.	Different numerical methods: finite volume, finite element, and finite difference methods
6-8	Basic finite difference methods for different equations: elliptic, hyperbolic, and parabolic equations
9-10	Programming to solve a model problem: e.g., convection and diffusion equation
11-14	Using FLUENT to solve a flow problem: e.g., point source pollution, channel flow

Grading: Homework: 20%
Projects: 40%
Exams: 40%