Spring 09 COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER

Instructor: Professor Sean Garrick, ME 245, (612) 624-5741, sgarrick@umn.edu.

Course Description: This course is intended for seniors and beginning graduate students interested in computer-based analysis of engineering problems in fluid mechanics and heat transfer. Traditionally, our ability to solve problems of engineering and scientific interest has been limited by the handful of analytical techniques - separation of variables, Green's Functions, Fourier analysis, etc. Numerical simulation has rendered such restrictions obsolete. The coupling of numerical methods, physics, and modern computing hardware has facilitated the birth of simulation as a new form of science. ME 5351 will take you beyond the trivial problems you've encountered in your Junior-level fluid mechanics and heat transfer courses.

You will be responsible for writing computer programs to solve problems involving steady and unsteady conduction, fully developed flows, and unsteady, quasi-turbulent flows. Introduction to the use of state-of-the-art computer tools for analysis and graphical representation of results will give you a broad view of computational transport phenomena in the fluid/thermal sciences. Successful completion of this course will equip you with the knowledge and skills needed to solve a wide variety of thermal sciences or transport phenomena problems.

Prerequisites: Fluid Dynamics and/or Heat Transfer, and working knowledge of computer programming. Those who have not taken these courses, please see me.

Grading: The final grade will be based on homework assignments (10%) and projects (90%).

Text: Hoffman, K.A. and Chiang, S., Computational Fluid Dynamics for Scientists and Engineers, Engineering Education System.

Topics to be Covered	Course Outline
Numerical Methods & Analysis	Finite Differences Spectral Methods Error, Stability & Consistency Analyses
Applied Mathematics	Ordinary Differential Equations Partial Differential Equations
Transport Phenomena	Fluid Mechanics Heat Transfer Control Volume Analysis Conduction & Convection Solution of the Navier-Stokes Equations and Convective Heat Transfer Problems
Grid Generation & Visualization	Conformal Mapping, Transformation Metrics and Good Grids Two- and Three-dimensional representation of multi-dimensional data-sets