Course Outline ME515 NUMERICAL HEAT AND MASS TRANSFER

Instructor: Dr. Cheng-Xian Lin
Office: 213 Perkins Hall (865) 974-6678, lincx@utk.edu
Office Hours MW 4:00-5:30PM

Term: Spring 2008
Class Time: TR 3:40pm-4:55pm
Class Room: DO 511

Catalog Course Description (Existing):
ME 515 Numerical Heat and Mass Transfer (3). Discrete modeling of Navier-Stokes equations and energy equations via control volume methods. Difference methods for discretization of convective term. Iterative solution algorithms for pressure-linked equations modeling forced and buoyancy driven flows. Computer project.

Objectives:

To introduce students with basic concepts and techniques in computational heat transfer and fluid dynamics, and to prepare students for development and application of computer codes for engineering design and scientific research.

Textbook:

Anil W. Date, Introduction to Computational Fluid Dynamics, Cambridge, 2005.

References:
1. S.V. Patankar, Numerical Heat Transfer and Fluid Flow, Taylor & Francis, 1980.
2. H. Versteeg and W. Malalasekera, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2nd edition, Prentice Hall, 2007.
3. J. H. Ferziger and M. Peric, Computational Methods for Fluid Dynamics, Springer, 3rd edition, 2002.

Tentative Course Schedule and Topics to be Covered:

Chapter	*Major Subject*	*HW/CP*	*Periods*
1	**Introduction to CFD/NHT** CFD/NHT and its applications; basic CFD/NHT philosophy; Navier-Stokes equations; general trasnsport equation format. Overview of programming language for scientific computing.	**HW#1**	**4**
2	**1D Heat Conduction** 1D conduction equation; grid and discretisation; TSE method; IOCV method; stability and convergence; explicit, partially implicit, and implicit procesures; nonlinearities; underrelaxation; Gauss-Seidel method; TDMA method; problems from related fields.	**HW#2, CP#1**	**6**
3	**1D Conduction-Convection** Exact solution; central difference scheme; upwind difference scheme; numerical false diffusion; hybrid and power-law schemes; total variation diminishing scheme; stability of the unsteady equation	**HW#3**	**4**
	Revew		**1**
	Mid-Term Exam (Thursday, March 13, 2008)		***1***
5	**2D Convection-Cartesian Grids** Staggered grid; collocated grids and discretization; SIMPLE series algorithms; multidimensional solvers; evaluation of residuals; boundary conditions; treatment of turbulent flows; smoothing pressure correction; selected applications in heat and mass transfer.	**HW#4,CP#2**	**6**
6	**2D Convection-Complex Domains** Curvilinear grids; coordinate transformation; unstructured grids and discerization; calculation procedures.	**HW#5**	**4**
8	**Numerical Grid Generation** Algebraic grid generation; differential grid generation; Sorenson's method; unstructured mesh generation.	**HW#6**	**2**
9	**Convergence Enhancement & Advanced Topics** Convergence rate; block correction; method of two lines; Stone's method; advanced topics in CFD.	**HW#7**	**1**
	Final Review		**1**
	Spring Break (Thursday, March 20, 2008)		***1***
	Final Exam (2:45pm-4:45pm Tuesday May 6)	Total =	31

Course Policies **ME515 NUMERICAL HEAT AND MASS TRANSFER**

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General Policies

1. Exams will cover all of the materials in the textbook, lectures in the class, homework assignments, computer programming, and handouts. Each exam will be closed book and in class.
2. Students who cannot attend an exam must contact the instructor beforehand. Except for extraordinary situations such as last minute illness and emergencies, there will be no makeup exam.
3. Homework and computer programming assignments are due at the very beginning of the same day class next week or at the time and date specified by the instructor. Late submission of homework and computer programming reports will result in earning of only half of the total original points. Selected assignments will be discussed during the class.
4. Students are responsible for obtaining a working copy of FORTRAN or C/C++ compiler, which does not have to be a state-of-the-art, as long as it works for the computer programming assignments.
5. Regular class attendance is expected for the students to be successful, but won't be used for students' final grading in this course.

Grading

The following points distribution or weigh factors will be used to determine each student's overall points for grading:

Homework:	20%
Computer Program:	20%
Midterm Exam:	25%
Final Exam:	35%
Total:	100%

Final grade will be determined based on the total percentage the students achieved:

90.0 < A ≤100.0;
85.0 < B+ ≤ 90.0;
80.0 < B ≤ 85.0;
75.0 < C+ ≤ 80.0;
70.0 < C ≤ 75.0;
60.0 < D ≤ 70.0;
F ≤ 60.0.