ME545
Computational Fluid Dynamics I
Syllabus
Spring 2009

Instructor: William W. Liou, Ph.D.
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Course Credits : 3
Prerequisites: ME356, CS201 or CS 306
Office Hours: M 11a.m.-12p.m., Class Hours: M 7:00p.m.-9:20p.m., Classroom: D0206

Course Description
This course introduces the beginning graduate and advanced undergraduate students to finite difference methods as a means of solving different type of differential equations that arise in fluid dynamics. Fundamentals of numerical analysis, ordinary differential equations and partial differential equations related to fluid mechanics and heat transfer will be reviewed. Error control and stability considerations are discussed and demonstrated. The Navier-Stokes equations will be solved using a commercial software.

Objectives
- Give the student a working knowledge of a variety of computational techniques that can be used for solving engineering problems.
- Develop a student's capability to write efficiently computer software.
- Develop a student's ability for result presentations and data visualization of engineering problems.

Text Book
J.C. Tannehil, D.A. Anderson, and R.H. Pletcher, *Computational Fluid Mechanics and Heat Transfer ,* 2nd Edition, Taylor & Francis, 1997, ISBN 1-56032-046-X.

References
J.H. Fereziger and M. Peric *Computational Methods for Fluid Dynamics*, 2001.
J.D. Anderson, Jr., *Computational Fluid Dynamics: The Basic with Applications,* McGraw Hill, Inc., 1995.
J.Tu, G.Yeoh, and C. Liu, *Computational Fluid Dynamics: A Practical Approach*, 2007.
H. Versteeg and W. Malalasekra, *An Introduction to Computational Fluid Dynamics: The Finite Volume Method*, 2007.
J.H. Kwon, A. Ecer, J. Periaux, and N. Satofuka, *Parallel Computational Fluid Dynamics 2006: Parallel Computing and its Applications*, 2007.
C.F. Gerald and P.O. Wheatley, *Applied Numerical Analysis,* Addison-Wesley, 1984.

Grading
5% : Homework Assignment
15% : One Test.
20% : Final Exam.
60% : Four (4) Computer Assignments (15% each)

Topics
- What is Computational Fluid Dynamics ?
- Finite difference approximations- Taylor series; truncation errors.
- Solution of ordinary differential equations
- Convergence and numerical stability
- Solution of parabolic flow problems
- Solution of hyperbolic flow problems
- Solution of elliptic flow problems

Notes

- No make-up exams will be given for reasons other than documented medical emergencies. In any case, the students must inform the instructor prior to the test. The points for that test will be added to the final exam. If a student misses more than one test, the other test will be graded as zero.
- Solve homework problems on engineering paper. Solve one problem on each page. All the assignments will be collected and graded. Hand in your paper before the class.
- Late homework penalty: 30\% for one day late, 60\% for two days and no credit for more than two days late.
- You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. [The policies can be found at http://catalog.wmich.edu under Academic Policies, Student Rights and Responsibilities.] If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.