Instructor: Dr. Thomas J. Barber
Course: ME318 Computational Methods of Viscous Fluid Dynamics
Time: Tuesday 4 – 7 PM

Text: **Computational Fluid Mechanics and Heat Transfer, 2nd Edition**
Anderson, D. A., Tannehill, J. C., and Pletcher, R. H.,
Taylor & Francis Publ. Corp.,
Levittown, PANew York, 1997.

Lecture	Topic	Anderson	Fletcher
1	Introduction, Governing Equations of Fluids, Nondimensionalization Limiting Forms Method of Characteristics I Classification of Problem Types, B.C.'s P1. Characteristics for system P2. Charac. for Navier-Stokes Eqns HO: Circ. cylinder: Sep. of variables, BCs	1.1-1.3 5.1.0-5.1.5 5.1.6-5.1.7 5.5.0-5.5.6 2.1.0-2.3.0 2.3.1-2.3.3	1.1-1.5 11.2.1-11.2.4 11.2.5 1.3 2.1 2.2-2.4
2	Numerical Methods Finite Difference Methods Finite Volume Methods P4. fx derivative for off-set cell P5. fx, and fxx on nonuniform mesh P6. Laplacian marix	3.0.0-3.6.-	2.5 3.1-3.2 5.2
3	Finite Element, Difference, and Volume Methods Accuracy Linear Systems P7. PDE using GE, GS, SOR	 4.3.3-4.3.4	5.1,5.3 3.3-3.4 6.2-6.3
4	Applications to Elliptic Problems Finite Difference Sol. of Circ. Cylinder Integral Panel Method P8. Finite difference/panel methods for non-lifting circular cylinder	4.3.0-4.3.4 --- 6.7	2.5.3 14.1.1-14.1.3
5	Elliptic Applications Cont'd	---	
6	Stability, Consistency, Convergence Grid Generation, Mesh Considerations P9. Truncation error P10. Grid generation problem	 5.6,10.1-10.5	4.1-4.6 13.1-13.4,
7	Mid-Term Examination		

8	Application to Parabolic Problems Non-steady Heat Conduction I P11. Consistency of parabolic difference formul. P12. Nonsteady heated rod	4.2.0-4.2.14	7.1-7.3
9	Application to Parabolic Problems Non-steady Heat Conduction II	4.2.0-4.2.14	7.1-7.3
10	Application to Hyperbolic Problems, I: Linear	4.1.0-4.1.10	9.1-9.5
11	Applications to Hyperbolic Problems, II: Nonlinear P13. Linear/Nonlin. 1D Hyperbolic Prob.	4.4.1-4.4.7	10.1-10.3
12	Applications to Systems of Equations		
13	Applications to Systems of Equations Thin Layer Anal. Boundary Layer Flows Effective Scales Effect Nonlinear Systems (B.L. Eqns)		5.3.0-5.3.2
14	Final Examination		
15	Hyperbolic Project Presentation Final Examination Review		

SUGGESTED REFERENCES

1. Fletcher, C. A. J., "Computational Techniques for Fluid Dynamics, Vol. I: Fundamental and General Techniques," Springer-Verlag, New York, 1988. (required)

2. Fletcher, C. A. J., "Computational Techniques for Fluid Dynamics, Vol. II: Specific Techniques for Different Flow Categories," Springer-Verlag, New York, 1988. (optional)

ADDITIONAL REFERENCES

1. Hoffmann, K. A., "Computational Fluid Dynamics for Engineers," Engineering Educational System, Austen TX, 1989.

2. Smith, G. D., "Numerical Solution of Partial Differential Equations: Finite Difference Methods,"Oxford University Press, New York, 1978.

3. Carnahan, B., Luther, H. A., and Wilkes J. O., "Applied Numerical Methods,"' John Wiley, New York, 1969.

4. Roache, P. R., "Computational Fluid Dynamics," Hermosa Publ., Albuquerque, 1972.

5. Hirsch, C., "Numerical Computation of Internal and External Flows, Vol. 1: Fundamentals of Numerical Discretization," John Wiley, New York, 1988.

6. Hirsch, C., “Numerical Computation of Internal and External Flows, Vol. 2: Computational Methods for Inviscid and Viscous Flows,”ohn Wiley, New York, 1988.

7. Sod, G. A., “Numerical Methods in Fluid Dynamics: Initial and Boundary Value Problems,” Cambridge Univ. Press, New York, 1985.

8. Chow, C. Y., “An Introduction to Computational Fluid Mechanics,” John Wiley, New York, 1979.

9. Peyret, R., and Taylor, T. D., “Computational Methods for Fluid Flow,” Springer-Verlag, New York, 1983.

10. Richtmyer, R. D., and Morton, K. W., “Difference Methods for Initial Value Problems,” John Wiley, New York, 1957.

11. Blottner, F. G., “Computational Techniques for Boundary Layer Flow,” AGARD Lecture Series 73, 1975.

12. Hess, J. L., “Review of Integral-Equation Techniques for Solving Potential Flow Problems With Emphasis on the Surface Source Method,” Computer Methods in Applied Mechanics and Engineering, Vol. 5, 1975, pp. 145-196.

Numerical Methods in Fluid Mechanics
Dr. T. Barber
Fall 2000

Class Policy

The course grade will be based on homeworks and in-class exams, and will be determined using the following weighting:

Homework	30%
Midterm Exam	35%
Final Exam	35%

It is important for you to note that I will subtract points from the homework problems if the work is not presented in a **neat and organized** manner. Please write the **problem statement** and **any assumptions** made. I suggest that after you work the problem through to your satisfaction the first time, you then neatly **rewrite** the problem. This will both help you to organize your thoughts and review the problem just worked -- last but not least, it will make it easier for me to grade the homeworks (very important!)

Exams are anticipated to be **open book**. Note that I will emphasize the understanding of **concepts**, which will be the main focus of the exams.

Homeworks are due on the class immediately following the one in which they are assigned, without exception. This is because I plan to go over, or at least hand out, the solutions to the problems during the next class. If you are going to miss a class, please make arrangements with a classmate to get the homework to me, and to obtain the new assignment. If this isn't possible, **contact me** for alternate arrangements.

Except for the first one, the reading assignments given in the syllabus should be completed **prior** to the class on which they are assigned for you to benefit the most from the class lectures.