MA 3243 (4-1) NUMERICAL SOLUTIONS OF P.D.E.'S
Text: J.C. Tannehill, D.A. Anderson, R.H. Pletcher
Computational Fluid Mechanics and Heat Transfer, 2^{nd} Edition

IV. Objectives

Upon successful completion of this course, one should be able to do the following:

1. Be able to de¯ne what a PDE is, its order, whether it is linear or not (and that linearity implies superposition of solutions is possible), and whether the PDE is of elliptic, parabolic, or hyperbolic type.

2. Be able to solve the 1D wave equation and 1D heat equation over ¯nite domains, as well as Laplace's equation over a rectangular domain by the method of separation of variables.

3. Be able to solve the 1D wave equation and ¯rst order wave equations by the method of characteristics over an in¯nite or semi-in¯nite domain.

4. Non-dimensionalize (or scale) a given linear PDE.

5. Construct consistent ¯nite di®erence approximations to linear elliptic, parabolic, and hyperbolic PDE's.

6. Incorporate Dirichlet, Neumann, and Robin boundary conditions into the ¯nite di®erence approximations of PDE's.

7. Determine the local truncation error of a given ¯nite di®erence approximation to a PDE being modelled, and determine the modi¯ed eq actually solved by the di®erence equation.

8. Know how to use the Thomas algorithm for solving tridiagonal systems of equations, and know under what conditions it is applicable.

9. Understand (to the degree provided by the text) the concepts of: local truncation error, stability, consistency, and convergence.

10. State the Lax Equivalence Theorem and explain how it is used, and/or what it means.

11. Perform an energy analysis of a PDE to determine whether a given problem is well posed.

12. Know how to apply the von Neumann stability test.

13. Write and debug programs to solve linear PDE's over relatively simple domains. For example: 1D Heat eq. using the Crank-Nicolson algorithm.

14. Explain the relative merits of the Explicit, Crank-Nicolson, and Implicit di®erence methods in the solution of 1-D parabolic PDE's.

15. Explain the relative merits of the \Point" Iterative methods in the solution of two and three dimensional elliptic PDE's.

16. Explain the relative merits of Iterative versus Direct methods in solving matrix equations arising from ¯nite di®erence algorithms.

17. Be able to calculate the dispersion and dissipative e®ects of applying ¯nite di®erence methods to hyperbolic PDE's, and understand their signi¯cance.