

# INTRO TO NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS

SPRING 2005

**Text:** *Into to the Numerical Solution of PDEs* by M.H. Holmes

**Course Web-Page:** <http://eaton.math.rpi.edu/faculty/Holmes/Courses/NumDiffEqs/S05/index.html>

## Tentative Outline

- I. Numerical Solution of IVPs [1 week]
  - a) finite difference methods
  - b) consistency, stability, and convergence
- II. Numerical Solution of 2-Point BVPs [3 weeks]
  - a) finite difference methods
  - b) consistency, stability, and convergence
- III. Numerical Solution of Parabolic PDEs [4 weeks]
  - a) explicit and implicit finite difference approximations
  - b) consistency, stability, and convergence
  - c) nonlinear problems
- IV. Numerical Solution of Hyperbolic PDEs [4 weeks]
  - a) finite difference approximations
  - b) consistency, stability, and convergence
  - c) numerical wave propagation, dispersion relationships, group and phase velocity
- V. Numerical Solution of Elliptic PDEs [3 weeks]
  - a) multidimensional problems
  - b) banded and sparse linear systems

**References:** Several references are available online, and these are listed on the course web-page

1. **Scientific Computing: An introductory Survey** by Michael T. Heath
2. **Numerical Analysis** by Burden and Faires
3. **Computational Methods in PDEs** by Mitchell
4. **Numerical Methods for PDEs** by Ames
5. **Numerical Methods for Differential Equations: Fundamental Concepts for Scientific and Engineering Applications** by Celia and Gray
6. **Finite Difference Schemes and PDEs** by Strikwerda

## Grading

Homework/Projects	50%
Exams	50%

## **Course Policies and Other Useful Information:**

**Homework:** There will be regular homework assignments and the scores for these assignments will contribute 50% of your course grade. The assigned questions must be written up neatly and all loose papers stapled together.

*Collaboration:* You are encouraged to discuss the problems with others, and to seek assistance from books, notes, etc. However, the work you turn in must be your own. It is not acceptable to copy any part of the homework solutions from another.

*Late policy:* All assignments will have a specific due date. Late homework will be accepted up to 5 weekdays after the due date provided the graded papers have not been returned yet. Each weekday late results in a 10% penalty . . . so work due Monday loses 10% if turned in by noon on Tuesday, 20% by noon on Wednesday, etc. If illness or an emergency prevents you from turning in homework, contact the instructor. Remember, it is always better to turn in an incomplete assignment rather than no assignment at all.

**Exams:** There will be two in-class exams and the scores on these exams will contribute 50% of your course grade (25% each). Exam questions will be based on the material covered in class, the text, and the homework problems.

**Academic Integrity:** Student-teacher relationships are based on mutual trust. Acts that violate this trust undermine the educational process. The *Rensselaer Handbook* defines various forms of academic dishonesty and procedures for responding to them. The penalties for cheating can include failure in the course and notification of the Dean of Students for further action.