

Syllabus – Math 572 Spring 2008 - TR 12:40-1:55, Ayres 309A

Course Information:

This course covers the Analysis of Numerical Methods for Differential Equations. We will cover methods for ordinary and partial differential equations, focusing primarily on finite difference type methods. Other topics covered include; polynomial approximation, numerical integration and the finite element method.

The prerequisites for this course are: Multi-variable calculus and analysis, some linear algebra, introductory numerical analysis/methods, some experience programming in FORTRAN, PASCAL, C, or a similar language and some experience with proofs.

Resources:

- ◇ Text: *Finite Difference Methods for Ordinary and Partial Differential Equations: Steady-State and Time-Dependent Problems*, by Randall J. LeVeque, SIAM, 2007. (If you are a SIAM member (or know one), you can get this book at a discount: \$44.10 + shipping from the [siam.org](http://www.siam.org) website)
- ◇ Handouts: for topics not covered in our text, available on the class webpage
- ◇ Web-page: <http://www.math.utk.edu/~ccollins/M572>

Grading:

- ◇ Homework (50%): 3-6 problems assigned weekly, primarily focusing on the theory, due the following week. You have one opportunity, during the semester, to turn in your homework 1 day late.
- ◇ Projectwork (30%): class and individual programming projects assigned over the semester emphasizing implementation of and experimentation with the numerical methods. More details later.
- ◇ Final Exam (20%). 2:45pm–4:45pm, Thursday, May 1.

Instructor:

Charles Collins - 312B Ayres Hall - 974-4269 or 974-2461 - ccollins@math.utk.edu
Office Hours: TWR 2-3 and by appointment

Course Outline: (references to resources in parenthesis)

1. Background

- (a) Basic Theory for PDEs; Classification (E.1)
- (b) Calculus review; Taylor expansion (Notes)
- (c) Big and Little 'Oh' notation; Errors and Norms (A.2, A.4, A.5)

2. Boundary Value Problems (BVPs)

- (a) Finite Differences: Derivation and Errors (1.1-1.5)
- (b) Finite Differences: Relation to Polynomials (Notes)
- (c) BVPs (1D)
 - i. Basic problem (2.1-2.3)
 - ii. Error analysis: local, global, stability, convergence (2.4-2.11)
 - iii. Other concerns and methods (2.12-2.21)
 - iv. Finite Element Method (Notes)
- (d) BVPs (n D) (3.1-3.7)

3. Initial Value Problems

- (a) Basic Theory for ODEs (5.1-5.2)
- (b) Basic Methods (5.3-5.6)
- (c) Numerical Integration (Notes)
- (d) Runge-Kutta Methods (5.7, Notes)
- (e) Linear Multistep Methods (5.9, Notes)
- (f) Zero-Stability and Convergence (6.1-6.4)
- (g) Absolute Stability and Stiffness (7.1-7.3+, 8.1-8.3+)
- (h) Time-Dependent PDEs (selections from Chapters 9, 10 and 11)

University's Honor Statement:

"An essential feature of the University of Tennessee is a commitment to maintaining an atmosphere of intellectual integrity and academic honesty. As a student of the University, I pledge that I will neither knowingly give nor receive any inappropriate assistance in academic work, thus affirming my own personal commitment to honor and integrity."

Plagiarism:

"Students shall not plagiarize. Plagiarism is using the intellectual property or product of someone else without giving proper credit. The undocumented use of someone else's words or ideas in any medium of communication (unless such information is recognized as common knowledge) is a serious offense, subject to disciplinary action that may include failure in a course and/or dismissal from the university. (from Hilltopics Student Handbook 2004-05, page 11)

For this class, this means that

1. You must document any homework solutions or programs you get from other sources (book, web, etc.). To document means to give the title, author and page number or web address. This should be at the beginning of your solution write up. You should also document when you get the main idea for the solution from another written resource or use a major theorem or result that is not in our primary text. You do not have to document results from our primary text.
2. Your written work must be your own. You may discuss homework problems with other students, but only in a fairly general way. You may not share written solutions. So once you start writing up your solution, do not discuss or share it with another student. It is as much of an offense to let someone copy your work as to copy someone's work.

If there is an obvious violation of these policies, you will receive a 0 on the problem (1st offense), 0 on the homework set (2nd offense), or 0 in the course and report to the administration (3rd offense). If there are signs but no obvious proof that such activity is going on (like too similar notation, examples, arguments or mistakes), I will give a warning (once).