

# MATH 572, Winter 2015

## Numerical Methods for Scientific Computing II

TTh 11:30-1:00PM, 4096 East Hall

**Instructor:** Smadar Karni, 4832 East Hall, 647-9720, karni@umich.edu

**Office Hours:** TTh, 1-2PM or by appointment

**Text:** *Finite Difference Methods for Ordinary and Partial Differential Equations* by Randall J. LeVeque, SIAM, 2007

Math 572 is an introduction to numerical methods for boundary value and initial value problems. It covers methods for ordinary and linear elliptic, parabolic and hyperbolic partial differential equations. The course will focus on the derivation of methods, on their accuracy, stability and convergence properties, as well as on practical aspects of their efficient implementation. This course should be very useful for students in applied and computational mathematics, and in any area of scientific computing and engineering. Students should have solid background in advanced calculus and linear algebra, and must speak a computing programming language such as Fortran or C (Matlab is fine too). Homework will be given regularly and will include programming assignments.

### Topics:

finite difference approximations, 2-point boundary value problems, consistency, stability, convergence, elliptic equations, solutions of linear systems, Gaussian elimination, Gauss-Seidel, Jacobi, SOR, Runge-Kutta methods, multistep methods, order of accuracy, root condition, absolute stability, stiff systems, A-stability, diffusion equation, method of lines, explicit and implicit finite-difference schemes, Crank-Nicolson, stability analysis by Fourier and energy methods, maximum principle, ADI and operator splitting, advection equation, CFL condition, Lax-Wendroff, dispersion relations, Lax equivalence theorem, discontinuous solutions, modified equation, artificial viscosity, boundary conditions, artificial boundaries, nonlinear hyperbolic equations

**Final Exam Date:** Thursday, April 23, 1:30 - 3:30PM.

**Grading:** Homework (30%), Midterm (30%), Final (40%)