Numerical Differential Equations Math 666 Fall 09

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Course Webpage: http://www.math.niu.edu/~awanou/courses/566

Office hours: M W F 10:00 am–11:50 am and by appointments

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Biography: I'm an assistant professor in the department of mathematical sciences. I received my Ph.d in mathematics in summer 2003 from the University of Georgia and spent two years as a postdoctoral associate at the Institute for Mathematics and its Applications, University of Minnesota. My research interests are primarily in the numerical analysis of partial differential equations.

Course information: MWF 09:00 am - 09:50 am DU 348

Textbooks: Finite Difference Methods for Ordinary and Partial Differential Equations: Steady-State and Time-Dependent Problems, Randall Leveque, SIAM 2007 and Understanding And Implementing the Finite Element Method, Mark S. Gockenbach, SIAM 2006.

Grade distribution: 50 % homeworks 10 % attendance 20 % midterm and 20 % final

Exams: There will be one midterm (in class) and one take-home final. No calculator will be allowed on the midterm.

Homeworks: Homeworks will be given each Wednesday and collected the following Wednesday. Late homework will be accepted only under special circumstances and with prior approval and will be discounted by 50 %. Homeworks with a coding component should be done in Matlab and the final output in readable form should be attached to the body of the homework. In addition you are required to email the m-files.

Course content: We will cover the syllabus of the numerical differential component of the numerical analysis qualifying exam. Students will be able to understand and implement finite difference and finite element methods.

Initial value problems for ODEs (Euler, multistep, backward difference and Runge-Kutta methods). Finite difference for elliptic PDEs (numerical differentiation, discretization of elliptic operators, existence and uniqueness of solutions to the discrete problem, error estimates in the L^∞ norm and L^2 norm for the solution of Poisson equation). Finite element for elliptic PDEs (Variational formulation of elliptic BVPs, Galerkin approximation, change of variables, trial functions of degree higher than 1, algorithm for constructing the discrete problem, structure of the stiffness matrix). Evolution equations (semidiscretization, parabolic equations using finite differences and finite elements, wave equation, transport equation, upwinding, Fourier stability method, shooting method). Iterative methods for solving systems of linear equations (Gauss-Seidel, Jacobi, steepest descent, conjugate gradient)

Disclaimer: This syllabus provides a general guide for the course: deviations may be necessary. Deviations from the textbook should be expected.