MA587 Syllabus
Numerical Solution of PDEs – Finite Element Method
Spring 2008

R&R Description: Introduction to finite element method. Applications to both linear and nonlinear elliptic and parabolic partial differential equations. Theoretical foundations described; however, emphasis on algorithm design and implementation.

Instructor: Dr. Mansoor Haider, HA306, 515-3100, m_haider@ncsu.edu

Time/Place: 8:30-9:45 TH, HA272

Office Hours: Tuesdays 12:30-1:30, Wednesdays 2-3, or by appointment

Prerequisites: MA501 (or equivalent), some knowledge of a high level programming language.

Textbook: *Understanding and Implementing the Finite Element Method*, by Mark S. Gockenbach, 2006, SIAM [required]

Grade: ~5-6 Homework Assignments **(45%)**
1 Mid-term Test **(25%)**
Take-Home Final Exam or Course Project **(30%)**

Final Exam: A take-home final exam will be handed out on the last day of classes (April 24, 2008) and will be due towards the end of the following week.

Course Project: As an alternative to taking the final exam, students may complete a course project on a topic that is approved by the instructor. Requirements for the project include an in-class presentation and submission of a written report. Students are encouraged to meet with the instructor to formulate a project topic that is complementary to their thesis research, or an area of interest. Presentations will take place during the final two weeks of classes, and project reports will be due during the final exam period. Project topics should be finalized no later than **February 28, 2008.**

Topics:

I. PDE Background: classification, analytical solutions on finite domains, maximum principles, consistency and convergence

II. One-dimensional Linear Problems: weak formulations, Galerkin method, finite element types, assembly, quadrature, implementation, visualization, theoretical considerations, applications

III. Two and Three-dimensional Linear Problems: Galerkin formulations, isoparametric elements, quadrature, implementation, mesh generation and visualization, theoretical considerations, applications

IV. Advanced Topics: extensions for non-linear FEMs, mixed methods, penalty methods, selected topics from the literature