Title and Course Number:

Numerical Solution of Partial Differential Equations, MATH 453, (4-0-4)

Course Description: Numerical solution of boundary value problems and initial-boundary value problems using finite difference and finite element methods. Analysis of stability, accuracy, and implementation of methods.

Prerequisites: Math 452

Textbook: Introduction to Numerical Methods (2nd Ed.), Burden and Faires

Goals and Objectives: Upon successful completion of this course a student should have a working understanding of:

- 1. Classification of PDE's and Basic Definitions
- 2. Numerical partial differentiation
- 3. Finite Differences Methods
- 4. Finite Element Methods

Content and Topics:

- 1. Classification of PDE's and Basic Definitions
 - (a) Parabolic, Hyperbolic, Elliptic Equations
 - (b) Initial Value and Boundary Value Problems
 - (c) Linear versus nonlinear
- 2. Numerical partial differentiation
 - (a) Taylor series and Taylor polynomials in two or more variables
 - (b) Forward, Backward and Centered Difference Formulas
- 3. Finite Difference Methods
 - (a) Explicit Methods
 - (b) Crank-Nicholson Method
 - (c) Other Implicit Methods
 - (d) Order of convergence and stability
- 4. Introduction to Finite Element Methods

Computer usage: Students will create several programs using the MATLAB software. These programs will be based on the theory presented in class and will be used to solve various problems.

Written communication requirements: Several written assignments will be collected throughout the term. There will be written exams covering both theory and application portions of the class, including a comprehensive final.