Mathematics 4335 – Partial Differential Equations

Student Learning Outcomes

1. **Students will demonstrate factual knowledge of mathematical notation and terminology used in this course.** Students will demonstrate the ability to read, interpret, and use the vocabulary, symbolism, and basic definitions that arise in the study of partial differential equations.

2. **Students will be able to describe the fundamental principles involved in the study of partial differential equations.** Students will demonstrate familiarity with the theorems about and the characteristics of various types of partial differential equations. For example, students will understand the concepts of existence and uniqueness of solutions, classifications of partial differential equations, and a variety of related solution methods.

3. **Students will develop specific skills, competencies, and thought processes sufficient to support further work in this or related fields.** Students will acquire a level of proficiency in the concepts and applications necessary for work in occupational fields requiring a background in Differential Equations. These fields might include computer science, engineering, the physical and natural sciences as well as mathematics.

4. **Students will be able to apply techniques and procedures covered in this course to solve problems.** Students will be able to determine appropriate partial differential equation models for problems arising in fields such as physics and engineering, and will be able to apply analytical techniques or numerical approximation methods to solve those problems.

Course Content

Textbook: *Partial Differential Equations for Scientists and Engineers* by Stanley J. Farlow

1. **Introduction:** Introduction to partial differential equations.

2. **Diffusion-Type Problems:** Parabolic Equations, Boundary Conditions, Derivation of the Heat Equation, Separation of Variables, Eigenfunction Expansions, Fourier Series and Transform, Laplace Transform, Convection.

3. **Hyperbolic-Type Problems:** The One-Dimensional Wave Equation, The D'Alembert Solution, The Finite Vibrating String, Wave Equation in Higher Dimensions, Fourier Transforms, Superposition, Method of Characteristics, Nonlinear Equations, Systems of PDEs

4. **Elliptic-Type Problems:** The Laplacian, Boundary-Value Problems, Dirichlet Problems, Spherical Harmonics, Green's Functions.

5. **Numerical and Approximate Methods:** Numerical Solutions for Elliptic Problems, Finite-Difference Methods.

Additional topics may be covered as time allows.