Math 464 – Partial Differential Equations

(Adopted, Fall 2006, Prerequisites and course description changed effective Spring 2016 by Department consent. Course objectives added.)

Course Description: Partial differential equations, heat equation, wave equation, Laplace's equation, Fourier series, Fourier transform, method of seperation of variables.

Prerequisites: Math 223, 250, 305, and 321 with a grade of C or better.

Course topics:

Chapter 1. Introduction to partial differential equations. Classification. 1.1 What Is a Partial Differential Equation? 1.2 Solving and Interpreting a Partial Differential Equation. (*) The method of characteristic should be covered with supplement.	
Chapter 2. Fourier Series. 2.1 Periodic Functions 2.2 Fourier Series 2.3 Fourier Series of Functions with Arbitrary Periods 2.4 Half-Range Expansions: The Cosine and Sine Series 2.5 Mean Square Approximation and Parseval's Identity 2.6 Complex Form of Fourier Series 2.7 Forced Oscillations 2.8, 2.9, 2.10: Results must be given, but the proofs may be outlined.	
Chapter 3. Partial Differential Equations in Rectangular Coordinates 3.1 Partial Differential Equations in Physics and Engineering 3.2 Modeling: Vibrating Strings and the Wave Equation 3.3 Solution of the One Dimensional Wave Equation:The Method of Separation of Variables 3.4 D'Alembert's Method 3.5 The One Dimensional Heat Equation 3.6 Heat Conduction in Bars: Varying the Boundary Conditions 3.7 The Two Dimensional Wave and Heat Equations 3.8 Laplace's Equation in Rectangular Coordinates 3.9 Poisson's Equation: The Method of Eigenfunction Expansions 3.10 Neumann and Robin Conditions 3.11 The Maximum Principle	
Chapter 4. Partial Differential Equations in Polar and Cylindrical Coordinates (Selected Sections from 4.1 – 4.4) 4.1 The Laplacian in Various Coordinate Systems 4.2 Vibrations of a Circular Membrane: Symmetric Case 4.3 Vibrations of a Circular Membrane: General Case 4.4 Laplace's Equation in Circular Region	
Chapter 7. The Fourier Transformation and Its Applications 7.1 The Fourier Integral Representation	

7.2 The Fourier Transform 7.3 The Fourier Transform Method	

The following topics are optional:

Chapter 6. Sturm-Liouville Theory with Engineering Applications. (OPTIONAL)
6.1 Orthogonal Functions
6.2 Sturm–Liouville Theory
6.3 The Hanging Chain

Textbook: Partial differential equations with Fourier series and boundary value problems, 2^{nd} edition, by Nakhi, H. Asmar, Prentice Hall, 2005

Course objectives: At the conclusion of this course, students should be able to

1. Describe real-world models using PDEs.
2. Solve first order PDEs using the method of characteristics.
3. Determine the existence, uniqueness, and well-posedness of solution of PDEs.
4. Solve linear second order PDEs using canonical variables for initial-value problems, Separation of Variables and Fourier series for boundary value problems.