University of Houston
Department of Mathematics
MATH 3363 - Introduction to Partial Differential Equations

Prerequisites: Math 2433 and either Math 3321 or Math 3331.

Course Description: Partial differential equations and boundary value problems, Fourier series, the heat equation, vibrations of continuous systems, the potential equation, spectral methods.

Text: *Applied Partial Differential Equations with Fourier Series and Boundary Value Problems,* Fourth Edition, by Richard Haberman, Pearson Prentice Hall Pub.

Course Outline:

Introduction. The following syllabus consists of 13 blocks of material. Each block represents two 75 minute or three 50 minute lecture periods. This leaves two (75 minute) or three (50 minute) lecture periods for in-class testing.

Block 1.

1.1-1.4: Derivation of the Heat Equation; standard boundary conditions
2.3.4: $-y'' = \lambda y$, subject to 4 basic sets of boundary conditions

Block 2.

2.3.1 - 2.3.3, 2.3.5-2.3.7: Heat equation in a rod with both ends at zero temperature.
2.4.1: Heat equation in a rod with both ends insulated; graphics

Block 3.

Examples + graphics: Homogeneous boundary data
Examples + graphics: Inhomogeneous boundary data

Block 4.

2.4.2. 3.1, 3.2: Circular ring ("5th" set of BC) and Fourier series
3.3.1, 3.3.2: Even & odd extensions; 2.3.6 & 2.4.1 revisited
Graphics: Convergence theorem & Gibbs phenomenon

Block 5.

4.2, 4.3: Derivation of wave equation; standard boundary conditions.
4.4: String with fixed ends, d'Alembert's solution.

Block 6.

Examples + graphics: Normal modes; specific initial data
7.3: Rectangular membrane with fixed boundary

Block 7.

Examples + graphics: Nodal curves; specific init data
7.7.5, 7.7.6: Euler's equation; Bessel's equation; graphics

Block 8.

7.7.7 expanded: Bessel functions: zeroes & orthogonality
7.7.1-7.7.4: Circular membrane: separation of variables & scaling

Block 9.

7.7.8: Circular membrane: Eigenfunctions & Initial value problems
7.7.9 + graphics: Circularly symmetric initial data.

Block 10.

2.5.1: Laplace's equation inside a rectangle
2.5.2: Laplace's equation on a circular disk.

Block 11.

2.5.4 expanded: Mean value property, Maximum principle, Poisson formula.
3.6, 10.3.1: Fourier convergence theorem in complex form.

Block 12.

10.3.2, 10.3.3: Fourier transform; Gaussians; graphics
10.6.3: Laplace's equation in a half plane.

Block 13.

10.4.3, 10.6.3: Convolution theorem. The half-plane revisited.
10.4.2, 10.4.3: Key properties of the transform; heat kernel.