Review for Exam 1 (PDE)

Please review all the material below. In addition, please review homework and examples from the notes.

- Section 1.1. PDE Models. Heat, wave, and Laplace equations. Initial conditions and boundary conditions. Verifying that a given function is a solution to an initial boundary value problem. Linear and nonlinear, homogeneous and nonhomogeneous equations. Superposition principle for linear equations.
- Section 1.2. Conservation laws. Derivation of conservation law. Advection equation and its general solution. Advection – decay equation. Method of characteristics.
- Section 1.3. Diffusion. Derivation of diffusion equation from a conservation law. Initial condition and types of boundary conditions for diffusion equation. Advection – diffusion and advection – diffusion – decay equation. Steady – state solutions.
- 4. Section 1.4. Diffusion and Randomness. Fundamental (point-source solution). Derivation of diffusion equation from random motion (pp. 43-45).
- 5. Section 1.5. Vibrations and Acoustics. Wave equation (without derivation). Initial conditions for wave equation. Types of boundary conditions for wave equation.
- Section 1.7. Heat Conduction in Higher Dimensions. Derivation of conservation law in 3 dimensions. Divergence theorem. Derivation of diffusion equation in 3 dimensions. Initial condition and types of boundary conditions for diffusion equation (i.e. Dirichlet and Neumann). Laplace and Poisson equations.
- Section 1.8. Laplace equation. Derivation of numerical approximation of Laplace equation (pp. 66-67). The maximum principle. Laplacian in spherical and polar coordinates.

Good luck!