Math 422: Applied Partial Differential Equations II (4-0-4)
May 1, 2020

Catalog Description: The second course in a three term sequence in applied partial di erential equations. Introduction to solution techniques using eigenvalues and eigenfunctions. Presentation of eigenfunctions which form orthogonal bases such as Bessel functions and Legendre Polynomials.

Course Objectives: After completing this course, students will be able to

1. Solve the heat equation, the wave equation, and the LaPlace equation in two and three dimensions, in various di erent geometries.
2. Use Sturm-Liouville operator theory to understand the properties of solutions to PDEs.
3. Solve various non-homogeneous partial di erential equations with or without non-homogeneous boundary conditions.

Learning Outcomes and Performance Criteria

1. Solve the heat equation, the wave equation, and the LaPlace equation in two and three dimensions, in various di erent geometries.

   Core Criteria:

   (a) Solve the heat equation, the wave equation and LaPlace's equation on rectangles or rectangular solids.

   (b) Use Bessel functions and Bessel's equation to solve various partial di erential equations in polar or cylindrical geometries.

   (c) Use Legendre polynomials and the Spherical Bessel functions to solve various partial di erential equations in spherical geometries.

2. Use Sturm-Liouville operator theory to understand the properties of solutions to PDEs.

   Core Criteria:

   (a) Decide whether or not an operator is self-adjoint.

   (b) Establish when all the eigenvalues of a Sturm-Liouville equation are positive.

   (c) Show that given eigenfunctions with distinct eigenvalues are orthogonal.

3. Solve various non-homogeneous partial di erential equations with or without non-homogeneous boundary conditions.

   Core Criteria:

   (a) Solve a Heat Equation with sources.

   (b) Solve a forced Wave equation.

   (c) Solve Poisson's equation in various geometries with non-homogeneous boundary conditions.