ROWAN UNIVERSITY
Department of Mathematics

Syllabus

Math 01.386 - Introduction to Partial Differential Equations

CATALOG DESCRIPTION:

Math 01.386 Introduction to Partial Differential Equations, 3 s.h.
Prerequisite: Math 01.231 (Ordinary Differential Equations) with a grade of C- or better

This course is a study of the solution and application of partial differential equations. Topics include derivations and solutions of the wave equation, Laplace's equation and heat equation, Fourier series and integrals, boundary value problems, Bessel functions and Legendre polynomials.

OBJECTIVES:

Students in this course will become familiar with the three types of partial differential equations (PDEs) mentioned above and see how each arises from a physical problem. For solutions, the technique of separation of variables is first applied to reduce a PDE to a system of ODEs (ordinary differential equations). Then the role of Fourier series and integrals in the solutions is studied. Solutions in other orthogonal functions will also be examined. The use of a high-level mathematics programming language (such as Mathematica) to facilitate the analytical computations is encouraged.

CONTENT:

1. Partial Differential Equations of Physics
- Linear Boundary Value Problems
- The Vibrating String
- Other examples of Wave Equations
- Conduction of Heat
- Laplace's Equation
- Cylindrical and Spherical Coordinates
- Types of Equations and Conditions

2. Superposition of Solutions
- Linear Combinations
- Series Solutions
- Separation of Variables
- A Plucked String

3. Fourier Series
- The Basic Series
- Examples
- Fourier Sine and Cosine Series

4. Orthogonal Sets of Functions
- Functions as Vectors
- Inner Products and Orthonormal Sets
- Generalized Fourier Series
- Sturm-Liouville Problems

5. Fourier Integrals

- The Fourier Integral Formula
- Sine and Cosine Forms
- Exponential Form

6. Boundary Value Problems

- Formal and Rigorous Solutions
- The Vibrating String, Initially Displaced
- Nonhomogeneous Differential Equations
- Elastic Bar
- Temperatures in a Bar
- A Dirichlet Problem

7. Bessel Functions and Applications

- Bessel's Equation
- Bessel Functions
- Differentiation and Recurrence Formulae
- Zeroes of the Bessel Functions
- Temperatures in a Long Cylinder
- Vibration of a Circular Membrane

8. Legendre Polynomials and Applications

- Derivation of Legendre Polynomials
- Legendre's Series
- Temperatures in a Hemisphere

TEXTS:

The following might be possible texts for this course:

1. Strauss, Walter A., Partial Differential Equations: An Introduction, 2nd ed., John Wiley & Sons, 2008.

2. Haberman, Richard, Elementary Applied Partial Differential Equations, 5rd ed., Prentice-Hall, 2013.

Reviewed: 04/2021