Spring 2016

Math 402 – Partial Differential Equations I (3)

Integral surfaces and characteristics of first and second order partial differential equations. Applications to the equations of mathematical physics.

Pre: 243 or 253A, or consent. Recommended: 244, 302.

Text: *Basic Partial Differential Equations*
by D. Bleecker & G. Csordas, Van Nostrand Reinhold, 1992

Chapter 1: REVIEW AND INTRODUCTION

1.1 Review of ODEs (2 hrs.)
1.2 Generalities About PDEs (2 hrs.)
1.3 General Solutions and Elementary Techniques (2 hrs.)

Chapter 2: FIRST–ORDER PDEs

2.1 First–Order Linear PDEs (Constant Coefficients) (3 hrs.)
2.2 Variable Coefficients (optional)
2.3 Higher Dimensions, Quasi–linearity, Applications (optional)
2.4 Supplement on General Nonlinear First–Order PDEs (optional)

Chapter 3: THE HEAT EQUATION

3.1 Derivation of Heat Equation and Solutions of the Standard Initial/Boundary–Value Problems (2 hrs.)
3.2 Uniqueness and the Maximum Principle (2 hrs.)
3.3 Time–independent Boundary Conditions (2 hrs.)
3.4 Time–dependent Boundary Conditions (optional)

Chapter 4: FOURIER SERIES AND STURM–LIOUVILLE THEORY

4.1 Orthogonality and the Definition of Fourier Series (2 hrs.)
4.2 Convergence Theorems for Fourier Series (3 hrs.)
4.3 Sine and Cosine Series (2 hrs.)
4.4 Sturm–Liouville Problems (optional)

Chapter 5: THE WAVE EQUATION

5.1 The Wave Equation – Derivation and Uniqueness (2 hrs.)
5.2 The D'Alembert Solution of the Wave Equation (3 hrs.)
5.3 Inhomogeneous Boundary Conditions and Wave Equations (3 hrs.)

Chapter 6: LAPLACE'S EQUATION

6.1 General Orientation (2 hrs.)
6.2 The Dirichlet Problem for the rectangle (2 hrs.)
6.3 Inhomogeneous Boundary Conditions and Wave Equations (3 hrs.)

Chapter 7: FOURIER TRANSFORMS (Optional)

7.1 Complex Fourier Series (2 hrs.)
7.2 Basic Properties of Fourier Transforms (2 hrs.)
7.3 The Inversion Theorem and Parseval's Equality (2 hrs.)

Course Objectives:. Upon successful completion, the student will have a foundation in the basic topics of the theory of Partial Differential Equations listed above in the syllabus. Emphasis on rigor will provide students the understanding needed for graduate work, and in the study of the logical foundations of mathematics.

Program Objectives:. Math 402 is a senior level course in partial differential equations, an important subject with many applications in the physical and biological sciences, and Engineering. This course promotes our goal that our students learn, understand, and be able to apply several mathematical topics at the junior and senior level, and that our students acquire the ability and skills to apply mathematics to other fields.