MATH 418  Partial Differential Equations

1. Catalog Description

MATH 418 Partial Differential Equations  4 units

Prerequisite: MATH 344. Recommended: MATH 304.

Mathematical formulation of physical laws. Separation of variables. Orthogonal functions and
Boundary value problems; nonhomogeneous techniques. Applications to heat flow, potential
theory, vibrating strings and membranes. 4 lectures.

2. Required Background or Experience

Math 344 or consent of instructor.

3. Learning Objectives

Students should:

a. Gain insight into and appreciation for the application of advanced mathematics to problems
   in physics and engineering.

b. Be guided through derivation of appropriate partial differential equations governing the
   behavior of several standard physical problems.

c. Use methods of solving three different types of second order partial differential equations
   with constant coefficients and various boundary conditions.

d. Work with Fourier series expansions through employment of separation of variables
   method.

e. Solve ordinary differential equations with variable coefficients through use of power series.

f. Become familiar with some properties of the most common special functions in physics
   and engineering.

4. Text and References

The instructor may choose a text or choose a text with similar content coverage and level.
Suggested texts include:

- Churchill, R. V. and J. W. Brown, Fourier Series and Boundary Value Problems
- Constanda, Christian, Solution Techniques for Elementary Partial Differential Equations
  and Boundary Value Problems
- Logan, J. David, Applied Partial Differential Equations
- Powers, David L., Boundary Value Problems
- Articolo, George A., Partial Differential Equations & Boundary Value Problems with Maple V
- Bassanini, Piero and Alan R. Elcrat, Theory and Applications of Partial Differential
  Equations
- Colton, David, Partial Differential Equations, An Introduction
- Farlow, S. J., Partial Differential Equations for Scientists and Engineers
- Humi, Mayer, and William B. Miller, Boundary Value Problems and Partial Differential

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Equations
- Pinsky, Mark A., Partial Differential Equations and Boundary Value Problems with Applications
- Snider, Arthur D., Partial Differential Equations: Sources and Solutions

5. Minimum Student Materials

Paper, pencils and notebook.

6. Minimum University Facilities

Classroom with ample chalkboard space for class use.

7. Content and Method

a. Introduction to partial differential equations
b. Mathematical modeling and derivation of partial differential equations for physical problems
c. The heat equation, the wave equation, and Laplace’s equation
d. Separation of variables
e. Review of Fourier series
f. Use of Fourier series in solutions of partial differential equations
g. Boundary value problems and Sturm-Liouville problems
h. Nonhomogenous problems and eigenfunction expansions
i. Green’s functions

Method

Lecture-discussion including chalkboard development, application problems, supervised work, and individual conferences.

8. Methods of Assessment

Comprehensive final exam, mid-term exams or quizzes, homework.