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 generalized Fourier series. Bessel functions, Legendre polynomials. Sturm-Liouville problem. 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 Elementay Partial Differential Equations
- Haberman, Richard, Elementary Applied Partial Differential Equations with Fourier Series 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

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

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

The primary methods of assessment are: essay examinations, quizzes and homework. Typically, there will be one or more hour-long examinations during the quarter, and a required comprehensive final examination. Students are required to show their work and are graded not only on the correctness of their answers, but also on their understanding of the concepts and techniques.