M531 Partial Differential Equations

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A partial differential equation (PDE) is by definition an equation involving several independent variables, a function u (say) of these variables, and the partial derivatives of u. As an example:

$$\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=1\,.$$

Two fundamental PDEs are the so-called heat and wave equations, and we shall study these (and others) in detail. PDEs are important in problems of many branches of science and engineering, as well as providing a stimulus and area of application for abstract mathematical analysis. The purpose of this course is to provide students with the techniques necessary for the formulation and solution of problems involving PDEs in courses of other disciplines, and to prepare students for further study in PDEs and linear analysis.

Text: *Elementary Partial Differential Equations* by P. W. Berg and J. L. McGregor

Syllabus: Chapters 1-5, and parts of Chapters 6, 9, and 11 of the text.

Boundary value problems for heat and wave equations: eigenvalue expansions, Sturm-Liouville theory and Fourier series. D'Alembert's solution to the wave equation; characteristics. Laplace's equation, maximum principles, Bessel functions.

Prerequisites: M252 and M337

Lectures: It is advisable to read ahead, two or three sections *before* each lecture. When reading a section, it is important to do so *actively*, that is, with pencil and paper. Try to do some of the examples presented and reproduce proofs which are given. This will give you a chance to ask questions in the subsequent lecture on any points that are not clear to you. *Regular attendance in class is very important*.

There will be three **office hours** per week: see blackboard for details.

Homework exercises and schedule are on blackboard. Please attach cover sheet and follow its instructions.

As in most Mathematics courses, homework is very important in understanding the material. Please note that your homework (and exams) will be assessed primarily on the methods you use, rather than a final answer. Therefore to get credit please show all you work clearly. The theory in this course (like most others) is *cumulative*, and so a thorough understanding of all the earlier topics is important in understanding subsequent sections.

Exams: There will be two midterms, and a final comprehensive exam. The weighting is roughly as follows:

Midterm 1	20 points
Midterm 2	20 points
Final exam	30 points
Homework	30 points (averaged over the semester)

The grade scale is as follows:

60% - 79% C; 80% - 85% B; 86% - 100% A.