UNIVERSITY OF NEBRASKA AT OMAHA

MATH 8250: Partial Differential Equations

TR 4:00 PM – 5:15 PM Instructor: Dr. Baccouch

Overview of Content: A partial differential equation (PDE) is an equation which imposes relations between the various partial derivatives of a multivariable function. This course covers the basic methods of PDEs. PDEs are fundamental in the application of mathematics to science and engineering. Many different techniques for solving these equations are discussed. Standard topics such as linear and nonlinear first-order equations, second-order linear elliptic, hyperbolic, and parabolic equations, Green’s functions, and Fourier series are included.

Purpose: This course introduces the student to PDEs, their theoretical foundations, and their applications, which include optics, propagation of waves (light and sound), electric field theory, diffusion, and fluid dynamics. PDEs are mathematical structures for models in science and technology. They’re of fundamental importance in physics, biology and engineering design with connections to analysis, geometry, probability, etc. The goal of this course is to introduce students, both pure and applied, to the basic concepts and methods that mathematicians have developed to understand and analyze the properties of solutions to PDEs.

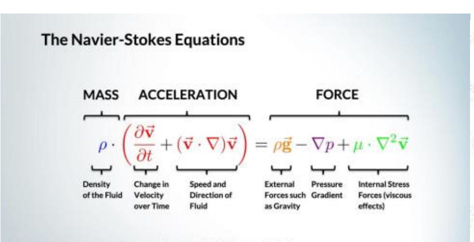
Course Description: This course is designed to meet the needs of science, engineering, physics, and mathematics students. We will cover basic techniques for analyzing PDEs and focus on several particular types of PDEs (linear and nonlinear) that allow us to find explicit solution formulas. This course covers the following materials: Transport equations; the method of characteristics; Classification of PDEs; Boundary value problems; Wave equations Heat/diffusion equations; Laplace equations; Maximum principle; Separation of variables; Fourier series; Fourier transform; Distributions; Green’s functions. The material presented is applicable to any field of study that makes use of PDEs to model its phenomena, whether that field is physics, finance, electrical engineering, or anything else.

Prereq: MATH 1970 and MATH 2350 or instructor’s permission. MATH 4330 is not required.

Basis for Evaluating Student Performance: Grades will be based on homework and exams.

Teaching Methodology: This course is presented by lecture, class discussion, and questions.

Textbook: Robert McOwen. Partial Differential Equations, Methods and Applications, 2nd Edition (2003); Prentice Hall; ISBN: 978-0-130-09335-6



$$\nabla\cdot\mathbf{E}=\frac{\rho_v}{\varepsilon} \quad \text{(Gauss' Law)}$$

$$\nabla\cdot\mathbf{H}=0 \quad \text{(Gauss' Law for Magnetism)}$$

$$\nabla\times\mathbf{E}=-\mu\frac{\partial\mathbf{H}}{\partial t} \quad \text{(Faraday's Law)}$$

$$\nabla\times\mathbf{H}=\mathbf{J}+\varepsilon\frac{\partial\mathbf{E}}{\partial t} \quad \text{(Ampere's Law)}$$

Black-Scholes Equation

$$\frac{\partial V}{\partial t}+\frac{1}{2}\sigma^2S^2\frac{\partial^2V}{\partial S^2}=rV-rS\frac{\partial V}{\partial S}$$

Developed by Fischer Black, Myron Scholes and Robert Merton in 1970s, the Black-Scholes equation calculates the profit on a financial derivative based on the stock price.

The Black-Scholes equation allows you to model the value of a financial derivative at various stock prices.

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