APMA 935 • Mathematical Modelling • Spring 2004

A Mathematical View of Modern Science

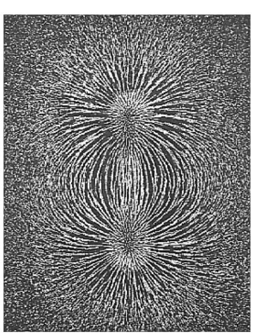
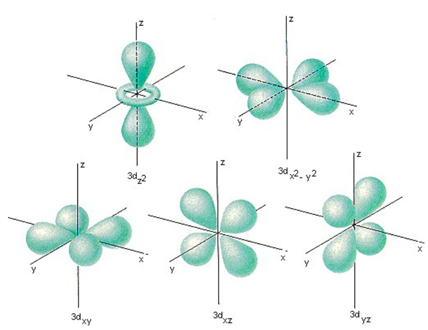
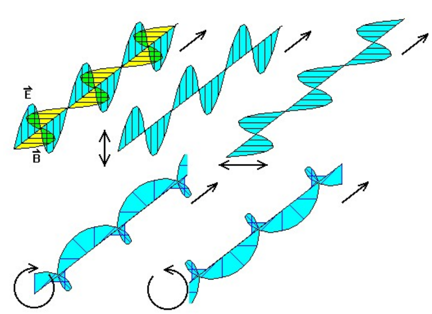
Development of the theory of partial differential equations (PDEs) was one of the key influences behind the scientific revolution of the late 19^{th}-century as it brought a powerful quantitative tool for the study of many problems in modern science. A complete applied mathematical study addresses two issues: translation of the scientific context with model equations (derivation & interpretation), and investigation of the mathematical properties of these equations (analysis, solution & computation). In this course, methods for the derivation, solution and computation of PDE models are discussed within the context of familiar examples from the physical sciences.

The lectures will discuss how the basic linear PDE trilogy, the diffusion, potential & wave equations, naturally arise in scientific theories such as probability, gravity and sound propagation. The analysis of these equations will also be revisited through the development of various solution techniques: eigenfunction expansions, Greens functions and integral transforms. Later lectures will present advanced examples involving systems of PDEs and nonlinearity.

Computer visualization will be an important accompaniment to the lectures and assigned work. Methods for numerical computing and graphics will be introduced through the use and modification of downloadable Matlab scripts.

Background familiarity with differential equations (ODEs & PDEs), complex variables & Matlab computing.

Further information & updates: www.math.sfu.ca/∼muraki

The images above are illustrations of magnetic field lines, electron orbitals and polarized light waves. The mathematical theories associated with these phenomena involve the Poisson, Schrödinger and Maxwell equations.