Math 152 Applications of Advanced Calculus II Spring 2009
Math 250 Nonlinear Partial Differential Equations

Course Information

BLOCK: E+: MW 10:30 - 11:45 pm (152); E+: MWF 10:30 - 11:45 pm (250).
INSTRUCTOR: Bruce Boghosian
EMAIL: `bruce.boghosian@tufts.edu`
OFFICE: 103 Bromfield-Pearson
OFFICE HOURS (FALL 2008): MW 2:45-4:30 pm
PHONE: 7-3054
PREREQUISITES: Math 38 or equivalent (all); Math 46 and 135 or equivalent (250).

Text (152): "An Introduction to Nonlinear Partial Differential Equation" by J. David Logan, Wiley Interscience (second edition, 2008) ISBN 978-0-470-22595-0.
Text (250): Logan's book (above), plus "Partial Differential Equations, Methods and Applications" by Robert C. McOwen, Prentice-Hall (2003) ISBN 0-13-009335-1.

COURSE DESCRIPTION:

For students taking Math 152, the focus will be on dynamical equations of hyperbolic and parabolic type for a wide variety of applications. Examples will be drawn from fluid flow, shock waves, traffic flow, shallow water waves, the Euler and Navier-Stokes equations, topological issues in hydrodynamics, magnetohydrodynamics, chemical reactions, biological pattern formation, and the dynamics of phase separation. Along the way, we will learn about the calculus of variations, the method of characteristics, linear stability theory, mode-coupling theory, asymptotic expansions, hodograph transformations, the Landau-Ginzburg and Cahn-Hilliard equations, reaction-diffusion equations, and universality classes.

Students taking Math 250 will additionally study existence and uniqueness theorems for PDEs, flow in porous media, immiscible flow, Hele-Shaw flow, dendritic growth, surface roughening, the Kurimoto-Sivashinsky equation, Lax pairs and conservation laws, inverse scattering, and classical Hamiltonian field theory.

Throughout the course, the emphasis will be on the use of partial differential equations for mathematical modeling of physical phenomena. Importance will be placed on the relation of the physical to the mathematical – starting with the derivation of the mathematical model from underlying physical law, progressing to the judicious use of approximations and asymptotics, the physical import of existence and uniqueness theorems for mathematical models, the analysis and solution of the model, and the physical interpretation of the solutions.