Northeastern University *Fall 2007*

MTH G202: Partial Differential Equations I

Preliminary Syllabus

This course introduces the student to partial differential equations, their theoretical foundations, and their applications, which include optics, propagation of waves (light and sound), electric field theory, diffusion, and fluid dynamics.

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Text: My textbook, *Partial Differential Equations: Methods and Applications, 2nd Edition, Prentice Hall, 2003.* If you purchase it through the NU Bookstore, bring me the receipt and I will refund you 10% of the price!

Prerequisites: Undergraduate ordinary differential equations (MTH U345 or equivalent) is essential; undergraduate partial differential equations (MTH U545 or equivalent) is very helpful.

Topics to be covered:

- First-order equations by the method of characteristics; linear, quasilinear, and nonlinear equations; applications to traffic flow and geometrical optics.
- Principles for higher-order equations; power series and Cauchy Kowalevski theorem; classification of second-order equations; linear equations and generalized solutions.
- Wave equations in various space dimensions; domain of dependence and range of influence; Huygens' principle; conservation of energy, dispersion, and dissipation; applications to light and sound.
- Laplace's equation; mean values and the maximum principle; the fundamental solution, Green's functions, and Poisson kernels; properties of harmonic functions; applications to vector fields.
- The heat equation; eigenfunction expansions; the maximum principle; Fourier transform and the Gaussian kernel; regularity of solutions; scale invariance and the similarity method; applications to fluid dynamics.

Grading: Weekly homework problems will be assigned and there will be a take-home final exam.