Math 545 Spring 2006
Stochastic Partial Differential Equations

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Class Hours: Mondays and Wednesdays 10:00–11:15am in SB 213
Office Hours: Mondays and Wednesdays 11:15am–12:05pm in E1 Room 115B

This course introduces various methods for understanding solutions and dynamical behaviors of stochastic partial differential equations arising from mathematical modeling in science and engineering and other areas. It is designed for graduate students who would like to use stochastic methods in their research or to learn such methods for long term career development.

Scientific, engineering and financial systems are often subject to random influence, such as stochastic forcing, uncertain parameters, noisy sources, and random boundary conditions. Taking stochastic effects into account is of central importance for the development of mathematical models of complex systems under uncertainty in engineering and science. Stochastic partial differential equations are appropriate models for randomly influenced infinite dimensional systems.

We will approach the subject from an applied and a dynamical systems point of view. Applications will be used throughout the course to motivate and illustrate basic concepts.

Topics include:

Random variables and Brownian motion in Hilbert spaces; Ito calculus in Hilbert spaces; Stochastic heat equation; Stochastic wave equation; Analytical and approximation techniques; Stochastic numerical simulations via Matlab; Dynamical impact of noises; Stochastic flows and cocycles; Invariant measures, Lyapunov exponents and ergodicity; Applications to engineering and science and other areas.

Reference books:

J. Zabczyk: A mini-course on stochastic partial differential equations. In "Progress in Probability", Vol 49, 2001, pages 257–284.

Background reference books:

B. Oksendal: Stochastic Differential Equations — An Introduction with Applications, Springer-Verlag; 6th edition, 2003. (*or similar books*)

M. Capinski & E. Kopp: Measure, Integral and Probability, Springer, 2nd Edition, 2004. (*or similar books*)

J. C. Taylor: An Introduction to measure and probability. Springer, 1996. (*or similar books*)

Tyn Myint-U: Partial differential equations for scientists and engineers, 3rd ed. North Holland, 1987. (*or similar books*)