MATH 516: STOCHASTIC DIFFERENTIAL EQUATIONS, Spring 2009

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TIME AND PLACE: TTh 1:00-2:15pm 220 Willard
OFFICE HOURS: T 5:00pm-6:00pm
webpage: http://www.math.psu.edu/~anovikov/math516/
PREREQUISITES: MATH416. **TEXT:** *notes* by L.C.Evans, see webpage.

COURSE DESCRIPTION	**No. of lectures**
0. INTRODUCTION: Random walk & Markov chain (1 lecture) (E1)	1
1. CRASH COURSE IN PROBABILITY (5 lectures)	
1.1 Random variable, expectation, distribution function, independence (E2A-D)	1
1.2 Borel-Cantelli, Kolmogorov Inequality & Laws of Large Numbers (E2E,G)	1
1.3 Weak convergence of measures, Characteristic functions &CLT (E2F,G)	1
1.4 Conditional expectation (E2H)	1
1.5 Stochastic processes, Filtrations, Martingales (E2I)	1
2. BASIC STOCHASTIC PROCESSES (4 lectures)	
2.1 Finite State Markov processes. Poison process	1
2.2 Wide sense stationary processes. Spectral representation.	1
2.3 Strictly stationary processes. Ergodicity & mixing.	1
2.4 Finite-dimensional distributions. Kolmogorov consistency theorem.	1
3. BROWNIAN MOTION (4 lectures)	
3.1 Levy-Ciesielski construction of Brownian motion.	1
3.1 Browian Motion & Random walk. Donsker`s theorem.	1
3.3 Kolmogorov`s tightness theorem. Holder continuity of sample paths.	1
3.4 Markov property	1
4. STOCHASTIC INTEGRALS (4 Lectures)	
4.1 Quadratic variation	1
4.2 Construction of the Ito integral	1
4.3 Properties of the Ito integral	1
4.4 Ito`s formula	1
5. STOCHASTIC DIFFERENTIAL EQUATIONS (6 Lectures)	
5.1 Definitions & examples. Linear SDEs	1
5.2 Existence and uniqueness of solutions.	1
5.3 Properties of solutions.	1
5.4 Stopping times. Optional stopping theorem	1
5.5 Numerical methods	2
6. APPLICATIONS (6 Lectures)	
6.1 PDE`s: Fokker-Plank, Backward Kolmogorov equations	1
6.2 Optimal stopping.	1
6.3 Option pricing. Girsanov`s transformation	1
6.4 Stochastic control of drift diffusion. Hamilton-Jacobi-Bellman equations	1
6.5 Jump-diffusion processes	1
6.6 Bayesian filtering	1
TOTAL PERIODS =	30

HOMEWORKS: Five homeworks due approximately every other Thursday, posted on the web. Specific dates are: Feb. 7, Feb. 21, March 6, April 10, April 24.
TAKE HOME MIDTERM will be given March 6 (last day before Spring break), due March 27.
COURSE GRADES: Grades will be assigned on the basis of 400 points, distributed as follows: Homeworks: 50 points each, Take home midterm: 150 points. Total= 5*50+150=400.

ACADEMIC INTEGRITY in *Policies and Rules, Student Guide to the University*, Policy 49-20.