Introduction to Stochastic Differential Equations
MATH 6490 — Spring 2007

Peter Kramer

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Classes Tuesdays and Thursdays, 4:00-5:50 PM in Troy 2015

Prerequisites Differential equations (MATH 2400 or equivalent) essential and a basic familiarity with probability theory (MATP 4600) would be helpful.

Requirements 4 or 5 homework assignments, which will be posted on the course website, and a final exam. The first homework will be assigned on January 25 and be due on February 8.

The course grade will be determined by a 70% weighting of homework and a 30% weighting of the final exam. Students whose homework shows clear positive evidence of representing their own thinking will be allowed to skip the final exam and have their course grade determined completely (100%) by their homework scores.

Each assignment and final exam will be scored out of 100 points, though usually more than 100 points are available so that students have some choice in which problems to invest their effort. I certainly do not expect every student to work on every problem, but rather expect students to work out some subset of the homework problems with care, diligence, and clarity of presentation. The grading standard will correspond to this expectation. That is, the full points for a problem are generally only awarded for a solution which approaches the problem with the elegance and efficiency which should be expected from a proper understanding of the lectures and the readings. Moreover, all nontrivial steps must be explained, particularly those involving the concepts and techniques covered in this course. Routine calculations involving lower-level mathematical manipulations such as matrix algebra and calculus can be summarized without providing details. If you use a numerical software package such as MATLAB or Maple to assist your calculations, please attach a copy of your code or worksheet.

Grading scale:

Average Score (rounded)	Grade
96–	A
90–95	A-
83–89	B+
76–82	B
70–75	B-
63–69	C+
56–62	C
50–55	C-
0–49	F

Late homework will be penalized 10 points per business day, and no credit will be awarded once solutions are posted (which can be as soon as the next class). A homework submitted on the due date but after the time specified will be penalized 5 points.

Grade Appeals First of all, you are always welcome to ask me during office hours, for an explanation for why a problem solution was deemed incorrect or incomplete. I certainly would like all students to understand how to solve the problems, and to resolve any confusion about what constitutes a proper solution. The following applies only to situations in which the student is asking for a change in the score.

The only circumstance under which an appeal of a homework score will be entertained is a demonstrable factual error in grading, meaning either that scores were incorrectly totaled, or a correct response was marked incorrect. To determine whether your response met the criteria for being deemed correct, you should first consult the homework solutions, when they are posted. Uniform standards for partial credit are applied for the class, so I will not revisit the amount of points awarded for an incorrect or incomplete solution just because you think or feel you deserved more points. Any request for a grade correction must be made within one week of the date the solutions are posted for that homework.

If you think you have not been meted due justice by me, your next step is to present your concern to the chair of the Department of Mathematical Sciences.

If any grade appeal is deemed to be frivolous (meaning it falls outside the guidelines of a legitimate appeal as described above), the student making the frivolous appeal will be warned. Any future frivolous appeal will be penalized by a deduction from the homework score equal to the number of points concerned in the frivolous appeal.

Academic Integrity You are encouraged to work in small groups on the homework assignments, but your actual solutions should be your own work. That is, you should feel free to discuss how to approach the problems, to consult on how to do certain calculations, or to check your results. But you should never be copying from other students. I will only give credit for work that demonstrates that you understand what you are doing. Therefore, be sure to explain all major steps, especially how you are setting up the problem. It is not necessary to provide detailed reports on routine calculations, but do at least explain in words what you are doing.

If you obtained assistance from anyone outside of the course or any written material beyond the lecture notes and the two recommended texts for the course, you must explicitly acknowledge the source.

If the solutions of two or more students do not demonstrate sufficient independence of thought, but do not rise to the level of academic dishonesty, then I may either simply split the points earned among all parties whose collective mind produced the solution or render all parties ineligible for exemption from the final exam. Flagrantly corrupt homeworks will earn no credit, and clear violations of academic integrity will also be reported to the Dean of Students' Office. The distinction between "insufficient independence of thought" and "academic dishonesty" is primarily a matter of whether the work demonstrates an intent to misrepresent one's own work. If you are not clear on the concept of academic dishonesty, you might consult the *Rensselaer Handbook of Students Rights and Responsibilities* or ask me directly about my expectations for integrity.

Attendance You don't have to tell me if you miss a class. But don't expect me to spend much time giving you help with homework if you're not attending class.

Course Objectives :

- Experience in setting up and using stochastic models to analyze systems with uncertainty
- Familiarity with mathematical methods of characterizing uncertainty and its evolution in time
- Education in fundamental techniques for analyzing stochastic differential equations

Topics :

- Review of Probability Theory
- Fundamentals of Stochastic Processes
- Stochastic Calculus
- Mathematical Theory of Stochastic Differential Equations
- Numerical Simulation of Stochastic Differential Equations
- Modeling with Stochastic Differential Equations
- Stochastic Filtering
- Coarse-Graining of Multiscale Stochastic Differential Equations

Textbook All are optional. You probably will want to purchase at least one, but I will excerpt some core reading material and post it on the website (through library reserves).

- Grigoriu, *Stochastic Calculus*: A mixture of a summary of rigorous mathematical theory with applications to science and engineering.
- Gardiner, *Handbook of Stochastic Methods* (Third Edition): A discussion of stochastic methods oriented toward physicists