ECE 5510: Random Processes, Fall 2017

Lecture: Tuesday and Thursday, 10:45am - 12:05pm in MEB 3147
Prerequisite: ECE 3530, Math 5010, or equivalent.
Credit: 3.0

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Web Page: Canvas: lecture notes, homework, handouts, etc.

Textbook: Roy D. Yates and David J. Goodman, *Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers*, Wiley, 3rd edition, 2014.

Description: This course first covers the fundamentals of probability, including conditional probability, independence, functions of and expectations of one or more random variables. Then, we address several aspects of random processes, including stationarity, power spectral density, linear time-invariant systems, and Poisson, Bernoulli, and Markov processes. The material in this course is necessary for further study and analysis in communication systems, signal processing, and controls. In addition, the ability to analyze random processes is a fundamental skill that will help you in other areas of engineering and science.

Grading: Overall course grade will be calculated based on:

- Class Participation: 2% (Notes scribing, class discussions, class attendance)
- Homework: 20% (The lowest homework score will be dropped)
- Midterm Exam 1: 25% (In class, tentative date: Thursday Oct 3.)
- Midterm Exam 2: 25% (In class, tentative date: Thursday November 16.)
- Final Exam: 28% (Monday December 11, 10:30 am - 12:30 pm)

Final Grades:

- Guaranteed Grades:
  - >90%: A 87–90%: A-
  - 83–87%: B+ 80–83%: B 77–80%: B-
  - 73–77%: C+ 70–73%: C 67–70%: C-
  - 63–67%: D+ 60–63%: D 57–60%: D-
  - <57%: E
- Curves: If necessary, the grading criteria may be curved to strictly improve (not worsen) the class's *overall* scores. Unless there are extreme circumstances, individual assignment / exam / lab grades will not be curved.

Lecture notes scribing: Each student will scribe 2 to 3 lecture notes, which will be posted on Canvas before the next lecture. In each class, two students will be randomly selected.

Homework: Homework will typically be assigned each Thursday and due the following Thursday at 5pm in the homework locker (**17**) at MEB. Homework will also be accepted up to 24 hours late (5pm on the next day) with a 10% penalty. No homework will be graded after that. Also, to allow for extenuating circumstances, the lowest homework score will be dropped when calculating the overall course grade.

Exams: Exams are closed book. Calculators, laptop computers, tables of integrals, etc. are not permitted. You are allowed to have one page (single-sided) of notes for the first midterm exam, two pages (single-sided) of notes for the second midterm exam, and three pages (single-sided) of notes for the final exam. The notes must be hand-written on standard size (8.5x11) paper, reduced size photocopying is not permitted.

Collaboration Policy: You are encouraged to work together on homework assignments whenever possible. Discussing problem solving approaches and techniques is a great way to learn. After making a genuine attempt to solve the problems, you are encouraged to discuss the answers with other students currently enrolled in ECE 5510 to check the answers and compare solution approaches. However, after such a discussion, you must complete your answers on your own, without referring to the solutions of other students. You may not use solutions from previous terms or from a solution manual. I do, in fact, notice copied solutions. Copied solutions will result in a homework grade of "0"; violations may also result in more serious penalties.

Course Outline

- Getting Started with Probability (Chapter 1): Set Theory, Probability Axioms, Conditional Probability, Independence.
- Discrete Random Variables (Chapter 3): Probability mass function (PMF), Cumulative Distribution Function (CDF), Expectation and variance of a random variable, Conditional PMF.
- Continuous Random Variables (Chapters 4): CDF, Probability density function (PDF), Expected values, Gaussian random variables, Transformation of a random variable.
- Pairs of Random Variables (Chapter 5,6,7 and supplemental notes): Joint CDF, PDF, Marginal CDF, PDF, Functions of two random variables, Conditioning, Bivariate Gaussian random variables, Transformation of a pair of random variables.
- Random Vectors (Chapter 8): Expected value vector and correlation matrix, Gaussian random vectors.
- Sums of Random Variables (Chapter 9): PDF of the sum of two random variables.
- Estimation of a Random Variables (Chapter 12): Optimum Estimation, linear Estimation.
- Stochastic Processes (Chapter 13): Basic definitions, Poisson process, Independent Increment Process, Auto-correlation, Cross-correlation, Stationary Processes, Wide sense stationary random processes, Brownian Motion Process, Gaussian Processes.
- Random Signal Processing (Supplemental and class notes): Linear filtering of a continuous-time stochastic process, Power Spectral Density, White Noise, Applications to digital communications.
- Markov Chains (Supplemental and class notes): Discrete-time Markov Chains, Transition probability matrix, Limiting state probabilities.