



ECE 5510: Random Processes, Fall 2009

- Lecture:** Tuesday and Thursday, 10:45 AM - 12:05 PM in WEB 2230
- Prerequisite:** ECE 3530, Math 5010, or equivalent
- Credit:** 3 hours
- Instructor:** Neal Patwari
- Office:** MEB 3120
- Office Hours:** Monday 4 - 5 PM, Tuesday 12:15 - 1:15 PM, Thursday 1 PM - 3 PM, and by appointment
- Email:** npatwari@ece.utah.edu
- Phone:** (801) 581-5917
- Grader:** Pooyan Amini. Ph: 801-581-3380, email: pooyan.amini@gmail.com. Pooyan Amini is available for office hours by appointment.
- Web Page:** We will be using WebCT/Blackboard, <http://webct.utah.edu/>. Please log in to the site to make sure that you have access to the class web page. Homeworks, homework solutions, handouts, lecture notes, and web links will be posted here.
- Textbook:** Roy D. Yates and David J. Goodman, *Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers*, Wiley, 2nd edition, 2004.
While this is a good book, the list price is very high. Please check for used copies, including online, where I've seen it in the \$50-\$70 range. The first chapter is available on WebCT, to provide a little bit more time for shipping.
- Description:** This course first reviews 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. This 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** Course grading will be calculated based on:
- Homework: 15% (your lowest homework score is dropped)
 - Discussion Item: 1%
 - Application Assignments: 10% (your lowest assignment score is dropped)
 - Exam 1 (in class, Tue. September 29): 22%
 - Exam 2 (in class, Tue. Nov. 10): 22%
 - Final Exam (Wed. December 16 10:30 am - 12:30 pm): 30%

Homework: Homework will typically be assigned each Thursday in class and be due the following Thursday at 5pm in the homework locker. The homework locker is located in the hallway on the 3rd floor of the MEB, near the southeast stairwell. One will be labeled, 'ECE5510'. 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, since solutions will be posted on WebCT within hours after the late homework deadline. Also, to allow for extenuating circumstances, the lowest homework score will be dropped when calculating the final grade.

Collaboration Policy: You are encouraged to work together on homework assignments and application 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 solutions 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.

Discussion Item: Once during the semester you will bring in something from popular or technical media (*e.g.*, newspaper, magazine, journal, internet, engineering magazine, etc.) or an item you've learned from experience on the job or from research, which relates to probability or random processes. We will spend 1-5 minutes during a class session discussing that item and how what we're learning in class gives us the tools to better understand that news or technical item. There will be a sign-up sheet which each student will sign up for a particular class. Please email me ahead of class time if you need particular media available or copies to be made.

Additional Resources:

These books will be at the library reserve desk for 2 hour loan:

1. John A. Gubner, *Probability and random processes for electrical and computer engineers*, Cambridge University Press, 2006.
2. Alberto Leon-Garcia, *Probability and random processes for electrical engineering*, Addison-Wesley, 1989.
3. Henry Stark and John W. Woods, *Probability and random processes with applications to signal processing*, Prentice Hall, 2002.
4. Dimitri P. Bertsekas and John N. Tsitsiklis, *Introduction to probability*, Athena Scientific, 2002.
5. Sheldon M. Ross, *Introduction to Probability Models*, Academic Press, 2006, 9th ed.
6. Leonard Mlodinow, *The Drunkard's Walk: How Randomness Rules Our Lives*, Vintage, paperback, 2009. Also published in hardcover by Pantheon, 2008.

This last book is a good read to motivate the study of random processes, and has a great discussion of why probability and random processes isn't very intuitive.

Tips:

1. Find another student or students to help you (or to help them) when you (they) have trouble with homework problems. Do that from the start!
2. Read the corresponding section in the book *before* lecture.
3. When you do not fully understand a topic in lecture or in the homework come to office hours **as soon as possible**. Topics build on each other, so you want to be sure not to fall behind – the longer you wait, the tougher it will be to catch up.
4. Do additional problems, beyond the homework.

Disability Accommodations

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

Tentative Course Schedule

Readings in italics are available on WebCT.

No.	Class	Topics	Y&G Reading	Due
1	Tue. Aug. 25	Overview, Appl. Assignment Intro		
2	Thu. Aug. 27	Sets, Axioms of Prob., Indep. of Sets	<i>1.1-1.4, 1.6</i>	
3 3	Tue. Sept. 1	Cond'l Prob., Trees, Law of Total Prob.	<i>Mlodinow handout</i> <i>1.5, 1.7</i>	
4	Thu. Sept. 3	Combinations, Discrete r.v.s I	<i>1.8-1.9, 2.1-2.4</i>	HW 1
5	Tue. Sept. 8	Discrete r.v.s II, Expectation,	2.3, 2.5	
6	Thu. Sept. 10	Continuous r.v.s, Method of Moments	3.1-3.5, 2.6, 3.7	HW 2
7	Tue. Sept. 15	Transformation of r.v.s	2.6, 3.7	Appl. 1
8	Thu. Sept. 17	Expectation of functions, Cond'l Distributions	2.7-2.9, 3.3, 3.8	HW 3
9	Tue. Sept. 22	Joint distributions, Random Vectors	4.1-4.5, 5.1-5.3	Appl. 2
	Thu. Sept. 24	Review		HW 4
	Tue. Sept. 29	Exam 1		
10	Thu. Oct. 1	Joint and cond'l pmfs, pdfs	4.8-4.10, 5.4	
11	Tue. Oct. 6	Expectation, covariance	4.7, 5.6	
12	Thu. Oct. 8	Transformation I	4.6, 5.5, 6.2	HW 5
Fall Break				
13	Tue. Oct. 20	Gaussian R.V.s	4.11, 5.7, 11.3	Appl. 3
14	Thu. Oct. 22	Transformation of R.V.s II	<i>Kay Sect. 10.7</i>	HW 6
15	Tue. Oct. 27	Bernoulli R.P.s, Poisson R.P.s I	10.1-10.5	
16	Thu. Oct. 29	Poisson R.P.s II, Indep. Increments	10.6	HW 7
17	Tue. Nov. 3	Autocov., Autocor., PSD	10.8, 10.10, 11.1	Appl. 4
	Thu. Nov. 5	Review		HW 8
	Tue. Nov. 10	Exam 2		Appl. 5
18	Thu. Nov. 12	Analysis of R.P.s	10.7, 10.12	
19	Tue. Nov. 17	Gaussian R.P.s	10.12	Appl. 5
20	Thu. Nov. 19	LTI Filtering of R.P.s, Spectral Analysis	11.1, 11.5, 11.8	HW 9
21	Tue. Nov. 24	Discrete-Time R.P. PSD & Filtering	11.2, 11.6, 11.8	
Thanksgiving Break				
22	Tue. Dec. 1	Markov Processes, Chains I	12.1, 12.2	
23	Thu. Dec. 3	Markov Chains II	12.3, 12.4	HW 10
24	Tue. Dec. 8	Analysis of Markov Chains	12.5	Appl. 6
	Thu. Dec. 10	Review		HW 11
	Wed. Dec. 16	Final Exam, 10:30am -12:30pm		