Boston University
Department of Electrical and Computer Engineering

EC505 – STOCHASTIC PROCESSES, DETECTION, AND ESTIMATION

Information Sheet
Fall 2009

Professor:	Clem Karl Rm 437, 8 St. Mary's Street 353-9788, **wckarl@bu.edu**
Office hours:	Wednesday, 10–11AM; Thursday, 8–9AM
Class:	MW 12-2, PHO205
Web Site:	http://courseinfo.bu.edu/courses/09fallengec505_a1/
Required text:	None
Notes:	*Course Notes on Stochastic Processes* by D. A. Castañon & W. C. Karl available from the class web site. In addition, other materials will be handed out throughout the term.
Prerequisites:	EC381 or EK500, Introduction to Probability EC401, Signals and Systems MA142, Linear Algebra In general the course assumes a fluency in linear systems as well as basic probability. A facility with linear algebra is strongly recommended and helpful. The subject material demands a high level of maturity, dedication, and commitment to understanding the concepts in depth.
Homework:	Homework will be assigned roughly weekly. They are for you to clear up your confusions with the material through extended thought, to develop proficiency through practice, and to learn the concepts. They must be handed in to me by the date they are due. No late homework will be accepted. Doing the homework will be essential to your understanding of the material. Do not wait till the last minute before doing the homework!
Exams:	There will be 2 exams during the semester and a final during the final exam period. Midterm 1 – Wednesday Oct 7, SCI 115 Midterm 2 – Monday Nov 9, SCI 115 Final – Friday, Dec 18, 3:00-5:00PM, TBD (But likely will change)
Grading Policy:	Homework: 10% Midterm 1: 30% Midterm 2: 30% Final: 30%

Course Policies

Academic Conduct

The student handbook defines Academic Misconduct as follows: "Academic misconduct occurs when a student intentionally misrepresents his or her academic accomplishments or impedes other students' chances of being judged fairly for their academic work. Knowingly allowing others to represent your work as theirs is as serious an offense as submitting another's work as your own." This basic definition applies to EC505. If you are ever in doubt as to the legitimacy of an action, please talk to me immediately. The penalities for plagiarism at BU are severe.

Make-ups

There will be no make-up exams. If you have a legitimate excuse, such as illness as documented by a doctor's note, then the scores of your other exams will be weighted more highly to compensate for the missed exam. If you do not have a legitimate excuse, you will be given a grade of zero for the exam.

Incompletes

Incompletes will not be given to students who wish to improve their grade by taking the course in a subsequent semester. An incomplete may be given for medical reasons where a doctor's note is provided. The purpose of incompletes are to allow a student *who has essentially completed the course* and who has a legitimate interruption in the course, to complete the remaining material in another semester. Students will not be given an opportunity to improve their grade by doing "extra work".

Homework, Dates, Etc.

Homeworks are due by noon on Fridays. Late homeworks will not be accepted. No homework scores will be dropped.

Students are responsible for being aware of the drop dates for the current semester. Drop forms will not be back-dated.

Syllabus

EC505 STOCHASTIC PROCESSES

Fall 2009

Topic	# Lectures	Reading Notes
I. Probability review	2-3	1, 2.1-2.2
probability space, axioms, definitions		
random variables		
random vectors		
II. Definition and characterization of random processes	5	2–4
distribution description		
moments, important classes of processes		
stationarity		
time averages and ergodicity		
mean square calculus, power spectral density		
Exam	1	
III. System response with random signals	3	5-7
LTI system response, Shaping filters		
discrete time linear models		
modulation & sampling		
IV. Signal detection	6	8, 9
detection/classification of a random variable		
detection of vectors & disc. time signals		
spectral decomp., Karhunen-Loève expansions		
detection of continuous time signals		
Exam	1	
V. Estimation	8-9	10,11,12
estimation of random variables, Bayesian estimation		
estimation of nonrandom variables, Maximum-likelihood		
Weiner filtering		
Kalman filtering		
Final Exam		

Schedule

EC505 STOCHASTIC PROCESSES

Fall 2009

Homework				
Out	Due	Lec #	Date	Topic # Covered
1		1	Wed 9/2	I
			Mon 9/7	Holiday – No Class
2		2	Wed 9/9	I
	1		Fri 9/11	
		3	Mon 9/14	II
3		4	Wed 9/16	II
	2		Fri 9/18	
		5	Mon 9/21	II
4		6	Wed 9/23	II
	3		Fri 9/25	
		7	Mon 9/28	II
		8	Wed 9/30	III
	4		Fri 10/2	
		9	Mon 10/5	III
5		E	Wed 10/7	EXAM #1
			Fri 10/9	
			Mon 10/12	Holiday – No Class
		10	Tue 10/13	III
6		11	Wed 10/14	IV
	5		Fri 10/16	
		12	Mon 10/19	IV
7		13	Wed 10/21	IV
	6		Fri 10/23	
		14	Mon 10/26	IV
8		15	Wed 10/28	IV
	7		Fri 10/30	
		16	Mon 11/2	IV
		17	Wed 11/4	V
	8		Fri 11/6	
		E	Mon 11/9	EXAM #2
9			Wed 11/11	Holiday – No Class
			Fri 11/13	
		18	Mon 11/16	V
10		19	Wed 11/18	V
	9		Fri 11/20	
		20	Mon 11/23	V
			Wed 11/25	Holiday
			Fri 11/27	Holiday
		21	Mon 11/30	V
11		22	Wed 12/2	V
	10		Fri 12/4	
12		23	Mon 12/7	V
		24	Wed 12/9	V
	11		Fri 12/11	Last day of classes
		F	Fri 12/18	EC505 FINAL 3:00-5:00PM

Reference Texts

1. H. Stark and J. W. Woods, *Probability Random Processes and Estimation Theory for Engineers*, Prentice-Hall, 1986. Nice alternative to text for some topics in the course, especially early on. On reserve.

2. K. Sam Shanmugan, *Random Signals: Detection, Estimation, and Data Analysis*, Wiley, 1988. On reserve.

3. A. Papoulis, *Probability, Random Variables, and Stochastic Processes*, 3rd ed., McGraw-Hill, 1991. On reserve.

4. R. M. Gray and L. D. Davisson, *Random Processes: A Mathematical Approach for Engineers*, Prentice-Hall, 1986. Bridges the gap between formal mathematical texts and engineering texts on probability theory. On reserve.

5. A. Drake, *Fundamentals of Applied Probability Theory*, McGraw-Hill, 1967. Basic engineering text on probability theory.

6. W. Feller, *An Introduction to Probability Theory and Its Applications*, Vols. I and II, Wiley, 1968. Valuable formal reference set on probability theory.

7. S. M. Kay, *Fundamentals of Statistical Signal Processing and Estimation Theory*, Prentice-Hall, 1993. Accessible and thorough treatment of estimation theory.

8. E. Lee and D. G. Messerschmitt, *Digital Communication*, Kluwer Academic, 1988. Advanced reading on applications in communication theory

9. M. Loeve, *Probability Theory I*, Springer-Verlag, fourth ed., 1977. Formal but reasonably readable treatment of probability theory. A classic.

10. A. V. Oppenheim and R. W. Schafer,*Discrete-Time Signal Processing*, Prentice-Hall, 1989. Standard text on discrete-time linear systems and signals.

11. A. V. Oppenheim and A.S. Willsky, *Signals and Systems*, Prentice-Hall, 1983. Basic undergraduate text on both continuous-time and discrete-time linear systems and signals.

12. E. Parzen,*Stochastic Processes*, Holden-Day, 1962. Classic, formal text on stochastic processes.

13. G. Strang, *Linear Algebra and its Applications*, Harcourt Brace Jovanovich, third ed., 1968. Standard reference text on linear algebra.

14. C. W. Therrien, *Discrete Random Signals and Statistical Signal Processing*, Prentice-Hall, 1992. Very accessible alternative to text for some topics in the course (all done in discrete-time).

15. H. L. Van Trees, *Detection, Estimation and Modulation Theory, Part I*, Wiley, 1968. Classic and valuable reference text on detection and estimation theory.