USC Viterbi School of Engineering

EE 503: Probability for Electrical and Computer Engineers (Spring 2019)

Course Description:	Rigorous coverage of probability, discrete and continuous random variables, functions of multiple random variables, covariance, correlation, random vectors and sequences, Markov chains, estimation, introduction to statistics.
Instructor:	P. Vijay Kumar
Class:	MW 2-3:50 pm, SOS B4
Office Hours:	F 2-4 pm, EEB 504
email:	vijayk@usc.edu – (include EE 503 in the subject line of your em)
Discussion Session:	F 1:00-1:50 pm (KDC 235)
TA :	Ye Wang
Office Hours:	TBD
em	wang316@usc.edu
Grader :	Peijun He
email:	peijunhe@usc.edu
Website:	USC Blackboard
Prereqs:	Multivariable calculus (Math 445 or equivalent) Fundamentals of Linear System Theory (EE301 or equivalent)
Other Requirements:	Basic computer skills (i.e., simple programs and plotting).
Exams, HW:	15% Homework, weekly 22.5% Midterm Exam 1, Feb. 11, (during normal class time) 22.5% Midterm Exam 2, March 22, (during the Discussion Session) 22.5% Midterm Exam 3, April 19, (during the Discussion Session) (best 2 of 3 midterm scores will be retained) 40% Final Exam, Monday May 6, 2-4 pm (2 hours) (as per final exam schedule) - each exam is closed book, no "formula sheet"

Course Objective: To understand the basic tools of probability and random variables so as to provide a basis for analysis and design in subsequent electrical and computer engineering classes. Suitable for any engineering or applied science discipline, including computer science and financial engineering.

Grading Policies:

- Homework will be assigned every week on Wednesday, and due the following Wednesday.
- **Late HW** will not be accepted. A late assignment results in a zero grade.
- **Make-up Exams:** No make-up exams will be given. If you cannot make the above dates due to a class schedule conflict, you must notify me by the last day to add/drop. If I cannot accommodate your schedule, you must drop the class. In the case of a required business trip or medical emergency, a signed letter from your manager or doctor is required. This letter

must include the telephone number of your doctor or supervisor. I must be notified as soon as possible in the case of an emergency.

- **Attendance:** Lecture attendance is strongly encouraged but not mandatory. However, students are responsible for all material presented in the lectures.

Required Textbooks:

1. Dimitri P. Bertsekas and John N. Tsitsiklis, *Introduction to Probability*, 2nd edition, by Athena Scientific, 2008. (B&T)

2. J. A. Gubner, *Probability and Random Processes for Electrical and Computer Engineers*, Cambridge University Press, 2006. (Gubner)

Recommended Textbooks:

1. A. Leon-Garcia, *Probability, Statistics, and Random Processes for Electrical Engineering*, 3rd Edition, Addison Wesley, 2008.

Course Outline

Lecture No. (approximate)	Topic	Source (textbook)	Chapter, Section (or page numbers)
1	Motivation	B&T	pages 2-3
	Example applications of probability	Gubner	pages 1-6
2	Set operations and inverse image	Gubner	Section 1.2
	Probability models	Gubner	Section 1.3
3	Axioms and properties of a probability measure	Gubner	Section 1.4
	Conditional probability	B&T	Section 1.3
4	Total probability theorem & Bayes' rule	B&T	Section 1.4
	Independence	B&T	Section 1.5
5	Computing probabilities through counting	B&T	Section 1.6
	Probability space, σ-algebra	Gubner	page 43
6	Discrete random variables: pmf, examples,	B&T	Chapter 2
	Functions of a RV, expectation and variance	B&T	Chapter 2
7	Joint pmf of 2 RVs; functions of 2 RVs;	B&T	Chapter 2
8	Conditional pmf, total probability theorem,	B&T	Chapter 2
9	Independence of discrete RVs	B&T	Chapter 2
10	Convergence of deterministic sequences and series	Rudin*	Chapter 3
11	Continuous random variables	B&T	Chapter 3
12	Cumulative distribution functions, Borel σ-algebra	B&T Gubner	Chapter 3 Section 5.5
13	Normal RV, jointly continuous RVs;	B&T	Chapter 3
14	Conditioning and Independence	B&T	Chapter 3
	Conditional expectation, total expectation;	B&T	Chapter 3
15	Bayes' rule for continuous RVs	B&T	Chapter 3
16	Derived Distributions, Functions of RVs;	B&T	Chapter 4
	Covariance and Correlation Coefficient	B&T	Chapter 4
17	Conditional expectation and variance	B&T	Chapter 4
	Transforms, moment generating function	B&T	Chapter 4
18	Limit theorems	B&T	Chapter 5
19	Central Limit Theorem	B&T	Chapter 5
20	Difference Modes of Convergence	B&T	Chapter 5
21-22	Random Vectors and Matrices	Gubner	Chapter 8
23	Estimation	Gubner	Chapter 8
24	Gaussian Random Vectors	Gubner	Chapter 9
25-26	Markov Chains	B&T	Chapter 7
27-28	Statistics	Gubner	Sections 6.1 to 6.5

*Walter Rudin, *Principles of Mathematical Analysis*, International Series in Pure & Applied Mathematics, 1976.