

EE 630 - Random Variables and Signals - 3 Hours
(old: EE 530 - Random Variables and Signals - 3 Hours)
Elective course for undergraduates prior to AY2008-09

1. *2008-2009 Catalog description*

Axiomatic probability; probability distributions; correlation functions; power spectral density; random processes; Markov chains and Markov processes; linear and non-linear systems with random inputs; linear mean square estimation; Wiener and Kalman filtering; applications to signal processing problems. Prerequisite: A minimum grade of B in EE 301 and EE 302 or equivalent; completion of a senior or graduate level course in the area of signals and systems.

(old: 1. *2007-2008 Catalog description*

Correlation functions; power-density spectra; transmission of random signals through linear and non-linear systems; linear mean square estimation. Prerequisite: EE 302 or graduate standing.)

2. *Prerequisites by topics*

- a Basic probability theory and random processes.
- b Linear system theory.
- c Fourier transform theory.

3. *Textbook(s) and/or other required material*

Required: Random Signals: Probability and Random Processes with Applications to Signal Processing, third edition, Henry Stark and John W. Woods, Prentice Hall, 2002.

4. *Class Schedule*

Three sessions per week, each 50 minutes, for 14 weeks

5. *Topics Covered (Outcomes influenced)*

- Axioms of probability (7 a, b)
- Probability distributions: Gaussian, uniform, exponential, Rayleigh, binomial, Poisson (7 a, b, d, e, f, g, h)
- Functions of random variables (7 a, b, d, e, f, g, h)
- Joint probability density functions and correlation (7 a, b, d, e, f, g, h)
- Markov process and Markov chain (7 c, f, g, h)
- minimization of mean square error (7 d, f, g)
- linear estimation theory (7 e, f, g)
- Kalman filtering (7 d, f, g, h)
- estimation and prediction techniques (7 d, f, g)
- Simulation techniques using MATLAB (7 b, c, d, g, h)

6. *Contribution of course to meeting the professional component*

Engineering science - 50%, Engineering design - 50%

7. *Course Outcomes (Program outcome contributions): In learning the course topics, the student will attain the following outcomes. (note – graded deliverables measure performance relative to the outcomes)*

- a The student will understand axiomatic probability theory. (9 A, B, C, D)
- b The student will understand important probability distributions (9 A, B, C, D)
- c The student will understand joint probability distributions (9 A, B, C, D)
- d The student will analyze random processes and sequences. (9 A, B, C, D)
- e The student will analyze Markov processes and Markov chains. (9 A, B, C, D)
- f The student will analyze and construct minimum mean-square error estimators. (9 A, B, C, D)
- g The student will understand parameter estimation. (9 A, B, C, D)
- h The student will construct and simulate Kalman filters. (9 A, B, C, D)
- i The student will study tracking problems in navigation. (9 A, B, C, D)

- j The student will simulate random processes and system responses using simulation software MATLAB. (9 A, B, C, D)

8. *Grading policy*

The final grade will be determined by the combined numerical results of all exams, homework scores, and take-home exam problems including computer projects.

Exam 1	25%
Exam 2	25%
Final Exam	30%
Homeworks and computer projects	20%

A grade of C corresponds to meeting the minimum competency required to understand course topics and meet course objectives.

9. *Relationship of course to program outcomes*

label	Program Outcomes (A Graduate from the program will:)	Contribution
A	have knowledge of the mathematical and scientific foundation of electrical engineering	Strong
B	have knowledge of and the ability to apply techniques and technology of electrical engineering	Strong
C	complete a design project sequence, culminating in a capstone project at or near the professional level	Moderate
D	understand that acquisition of new knowledge is needed for success in the electrical engineering profession	Moderate
E	meet Bradley's general education requirements which are based on the principles of liberal education	NA
F	have experience in communicating technical information and working on teams	Moderate
G	understand the importance of professional and ethical behavior	Moderate

10. *Prepared by:* In Soo Ahn *Date:* 5/21/2008