EE:465

Probability Theory with Engineering Applications

Department of Electrical Engineering

King Saud University

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Course Material: Will be provided through LMS system

Pre-requisite: STAT-101

Lecture Schedule and Location:

Textbook: Alberto Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, Prentice Hall, 3rd Edition, 2008.

http://www.sze.hu/~harmati/Sztochasztikus%20folyamatok/Prob_Stat_RandProc_EE_Leon_Garcia.pdf

References: Probability and Random Process with Applications to Signal Processing, Henry Stark and John W. Woods , Third Edition, Pearson Education, 2002

Course Objectives: The main objectives of this course are to introduce students to the concepts of probability theory and random processes that are required to understand probability and stochastic models used in electrical and computer engineering, and to present some of the techniques that are needed to develop probability and stochastic models.

Evaluation: The grading system applied in this course is as follows:

60% Mid Exams/Quiz/HW etc

40% Final Exam

Office Hours:

Course Outline (Book Section Wise)

Probability Models, Probability and Axioms of Probability (LectureSlides#1, Chapter#1,2, Mid Exam, Final)

1.1 Mathematical Models as Tools in Analysis and Design
1.2 Deterministic Models
1.3 Probability Models
2.1 Specifying Random Experiments
2.2 The Axioms of Probability
2.4 Conditional Probability
2.5 Independence of Events
2.7 Synthesizing Randomness using Matlab

Discrete Random Variables: **(Chapter#3, LectrureSlide#2, Mid Exam, Final)**

3.1 The Notion of Random Variables
3.2 Discrete Random Variables and Probability Mass Function
3.3 Expected Value and Moments of Discrete Random Variable
3.5 Important Discrete Random Variables

One Random Variable: (**Chapter#4, LectureSlide#3, Mid Exam, Final)**

4.1 The Cumulative Distribution Function (CDF)
4.2 The Probability Density Function (pdf)
4.3 The Expected Value of X
4.4 Important Continuous Random Variables
4.5 Functions of Random Variables
4.6 The Markov and Chebyshev Inequalities
4.7.1 The Characteristic Function and Moment Generating Theorem
4.9 Computer Methods for Generating Random Variables

Sums of Random Variables and Long-Term Averages: (Chapter#7, LectureSlides#4, Final),

7.1 Sums of Random Variables, Mean and Variance of Sum of 'n' IID Random Variables
7.2 The Sample Means and the Laws of Large Numbers
7.3 The Central Limit Theorem

Random Process: (Chapter#9, LectureSlides#5, Final)

9.1 Definition of a Random Process
9.2 Specifying a Random Process (Continuous-Time Only)
9.5.1 Gaussian Random process (Continuous-Time Only)
9.6 Stationary Random Process (Wide-Sense-Stationary (WSS))

Analysis and Processing of Random Signals: (Chapter#10, LectureSlides#6, Final)

10.1 Power Spectral Density (Continuous-Time)
10.2 Response of Linear Systems to Random Signals (Continuous-Time)

List of Topics

	Topics	Duration (Weeks)
1	**Mathematical Modeling:** deterministic and probability models. **Basics of probability:** random experiments, discrete and continuous sample space, conditional probability, Baye's rule, independence of events, synthesizing randomness	2
2	**Single Random Variable:** Discrete-type random variable, Distribution and Density and Probability Mass function, function of random variable, Markov and Chebyshev Inequality, Important types of discrete and continuous random variables, computer generation of random variables	3
3	**Characterization of random variable:** Mean, variance and moments, transform methods, characteristic function, moment generating theorem	2
4	**Sum of random variables:** central limit theorem. Electrical engineering applications of random variables	2
5	**Random Process:** definition and characterization of random process. Auto-correlation and auto-covariance of random process. Gaussian random process. Linear systems with random inputs: Spectral characteristics of system response. Engineering applications of random processes.	2