ECE 5605

STOCHASTIC SIGNALS AND SYSTEMS

Textbook: A. Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering (Pearson/Prentice Hall, Upper Saddle River, NJ, 2008), 3rd Edition.

Course Outline:

I. **Probability Theory: An Axiomatic Approach** (Chapters 1, 2)

A. The meaning of probability
B. Probability space
C. Conditional probability
D. Independence
E. Joint and marginal probabilities

II. **The Concept of a Random Variable** (Chapters 3, 4)

A. Random variable
B. Probability (mass) distribution function
C. The cumulative distribution function
D. Probability density function
E. Examples of common distribution functions and probability density functions

III. **The Concept of a Random Vector** (Chapters 5,6)

A. Random Vectors
B. Joint probability (mass) distribution functions
C. Joint cumulative distribution functions
D. Joint probability density functions
E. Conditional probability distribution and density functions
F. Independent random variables

IV. **Functions of a Random Variable** (Chapter 4)

A. The concept of a function of a random variable
B. Distribution and density functions
C. Expected values; moments; characteristic functions

V. **Functions of a Random Vector** (Chapters 5, 6, 8)

A. Scalar-valued functions of a random vector
B. Vector-valued functions of a random vector
C. Expected values; moments; characteristic functions
D. Multivariate Gaussian random variables

E. Mean-square estimation

VI. **Stochastic Processes** (Chapter 9)

A. Definition; notation; types of processes
B. First- and second-order statistics for real scalar- and vector-valued stochastic processes
C. Nth-order statistics
D. Stationary processes
E. Transformation of stochastic processes (linear and nonlinear response to random inputs)
F. Stochastic differentiation and integration; ergodicity
G. Stochastic differential equations

VII. **Spectral Analysis** (Chapter 10)

A. Stationary processes
B. Power spectral density