ECE 560 – Stochastic Signals and Systems (Winter 2020)

Instructor: Prof. Thinh Nguyen

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MW noon-1:50 PM, KEC 1001

**Required Text:** Henry Stark and John W. Woods, **“**Probability, statistics, and random processes for engineers, 4th edition

**References:**

1) H. Haddad, “Probabilistic Systems and Random Signals,” Prentice Hall, 2006.

2) Papoulis and S. U. Pillai, "Probability, Random Variables and Stochastic Processes," McGraw-Hill, 4-th edition, 2002.

**Prerequisites:**

Graduate standing in ECE; Communications Systems (ECE461/561 or equivalent preferred); Introduction to Probability and Random Signals (353 or equivalent).

**Course Content:**

1. **Self review** of chapters 1-4

2. **Review** of moments (Chapter 4)

2.1. Expected values of a random variable

2.2. Moments

2.3. Moment-generation functions

2.4. Characteristic functions

3. Random vectors and parameter estimation (Chapter 5)

3.1. Joint distribution and densities

3.2. Multiple transformation and random variables

3.3. Expectation vectors and covariance matrices

3.4. Simultaneous diagonalization of two covariance matrices

3.5. Multidimensional Gaussian law

3.6. Characteristic function of random vectors

3.7. Parameter estimation and maximum likelihood estimators

4. Random sequences (Chapter 8)

4.1. Basic concepts

4.2. Basic principles of discrete-time linear systems

4.3. Random sequence and linear systems

4.4. WSS random sequences

4.5. Markov random sequences

4.6. Vector random sequences

4.7. Convergence of random sequences

4.8. Laws of large numbers

5. Random processes (Chapter 9)

5.1. Important random processes

5.2. Continuous-time linear systems with random inputs

5.3. Classifications of random processes, WSS processes, and LTI systems

5.4. Periodic and cyclo-stationary processes

5.5. Vector processes and state equations

6. Applications

6.1. Innovation sequences and Kalman filtering

6.2. Wiener filters for random sequences

6.3. Hidden Markov model

6.4. Spectral estimation

**Grading Policy**

Quiz: 3 quizzes, each 5%

Homework 15%

Midterm 30%

Final 40%

**Homework and projects:**

All are expected to complete the assigned homework problems. No late homework will be accepted.

**Office hours:**

MW 10:45 – 11:45 AM