

**ECE U468 Noise and Stochastic Processes, Spring 2005**  
**School of Electrical and Computer Engineering**  
**Northeastern University**

**Instructor:**

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**Teaching Assistant:**

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Office Hours: Wed 2-4pm, Fri 10-11am

**Class Hours and Location:**

9:15-10:20am MWTh, 108-G West Village

**Course Description:**

Discusses the physical origins of noise and models for its analysis in electronic devices, analog and digital systems, and communications. The basic theory of discrete and continuous probability, correlation, covariance, and power density spectra is developed and used to discuss random variables and stochastic processes, with application to the analysis of signals in the presence of noise in analog and digital systems.

**Prerequisites:**

Courses: ECE U464.

Topical: Linear systems. Transform techniques (Fourier, Laplace, and Z-transforms). Convolution integral. Properties of LTI systems. Linear algebra. An introductory probability course is extremely helpful, though not required.

**Textbooks:**

- [1] "Probability and Random Processes for Electrical Engineering, 2<sup>nd</sup> edition," by Alberto Leon-Garcia, Prentice Hall, 1994. On reserve at Snell Library. (Required)
- [2] "Student's Solution Manual 2<sup>nd</sup> edition," by Alberto Leon-Garcia, Prentice Hall, 1994. (Optional)

**Reference Books (on reserve at Snell Library):**

- [1] "Probability, Random Processes and Estimation Theory for Engineers, 3<sup>rd</sup> edition," by Stark & Woods, Prentice Hall, 1994.
- [2] "Probability, Random Variables, and Stochastic Processes, 4<sup>th</sup> edition," by A. Papoulis, McGraw-Hill, 2001.
- [3] "A First Course in Probability, 6<sup>th</sup> edition," by Sheldon Ross, Prentice Hall, 2001.
- [4] "The Probability Tutoring Book," by Carol Ash, IEEE, 1993.

**Grading Policy:**

Homework: 10%, due at the beginning of class on due date.  
Exams: 55%, see schedule below.  
Final Exam: 35%, comprehensive.

- No late homeworks will be accepted after solutions have been handed out and/or posted on the class website.
- No make-up examinations will be given.

**Examination dates:**

Exam #1: February 24, 2005, 2:50pm-4:30pm, 108-G West Village  
Exam #2: March 24, 2005, 2:50pm-4:30pm, 108-G West Village  
Final Exam: April 20, 2005, 1:00 pm, room: TBD

**Email and Course Web Page:**

- **You are required to send me an email with your legal name (and preferred name, if applicable), email address, and course title (ECE U468) no later than 01/07/2005 so that I can construct an email list for this class.**
- All students are required to check their email everyday for any class updates or notices.
- Any changes or updates to the class syllabus or schedule will also be posted on the class website. Copies of homeworks, exams, and solutions will be posted there as well.

**Special Needs:**

Any student requiring any special accommodations because of a disability, please see me during office hours or send me an email immediately so that appropriate arrangements can be made. If special testing arrangements are required, you must bring your DRC letter to me immediately so that examination rooms can be reserved on your behalf.

## Topical Outline:

|   |            |
|---|------------|
| Basic Concepts of Probability Theory                | Chapter 2  |
| Sample space, events, set operations                |            |
| Axioms of probability                               |            |
| Counting methods                                    |            |
| Conditional probability                             |            |
| Independent events                                  |            |
| Sequential experiments                              |            |
| Random Variables                                    | Chapter 3  |
| Cumulative distribution function (CDF)              |            |
| Probability distribution function (PDF)             |            |
| Important random variables (discrete & continuous)  |            |
| Functions of a random variable                      |            |
| Expected value of a random variable                 |            |
| Markov and Chebyshev inequalities                   |            |
| Goodness-of-fit                                     |            |
| Transform methods                                   |            |
| Multiple Random Variables                           | Chapter 4  |
| Vector random variables                             |            |
| Pairs of random variables                           |            |
| Independence of two random variables                |            |
| Conditional probability and conditional expectation |            |
| Functions of multiple random variables              |            |
| Expected value of functions of random variables     |            |
| Jointly Gaussian random variables                   |            |
| Sums of Random Variables and Long-Term Averages     | Chapter 5  |
| Sums of random variables                            |            |
| Sample mean and the laws of large numbers           |            |
| Central limit theorem                               |            |
| Random Processes                                    | Chapter 6  |
| Discrete-time random processes                      |            |
| Continuous-time random processes                    |            |
| Stationary random processes (RP)                    |            |
| Wide-sense stationary (WSS) RP                      |            |
| Cyclostationary RP                                  |            |
| Continuity, derivatives, and integrals of RP        |            |
| Time averages and ergodic theorems                  |            |
| Analysis and Processing of Random Signals           | Chapter 7* |
| Power spectral density                              |            |
| Response of linear systems to random signals        |            |

\* time permitting