ECE 5810
Spring 2009
Severance

Course Syllabus
Probabilistic Methods of Signal and Systems Analysis

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Office Hours: *To be announced*
Monday:
Tuesday:
Wednesday:
Thursday:
Friday:

Prerequisites:
Graduate student status in ECE

Materials:
[we will be following this]: *Probabilistic Methods of Signal and System Analysis* (third edition) by George R. Cooper and C lare D . McGillem; Oxford Press.

[optional]: *Probability and Statistics*, Schaums' s outline series (calculus based only!); published by McGraw Hill.

Limited function calculator: mathematical functions only - no programming or graphical capabilities. I recommend one of the TI 30X series of calculators ($10).

Access to MatLab and other miscellaneous utility software - either your own student edition or use the CAE center.

Grading:
There will be twelve assignments spaced evenly throughout the course. These will include both theory and practice, paper & pencil based and computer based exercises. Each of these will be graded and returned at the next class period. Also there will be three tests (50 minutes each) and one comprehensive final examination (two hours). The relative weight of each will be as follows:

12 assignments:	**10**%
3 tests (20% each):	**60**%
1 final examination:	**30**%

The final grading scale will be based on overall class performance. Historically, the class GPA has been approximately 2. 25. Your interim grades and class standing will be published after each "opportunity" (test). If there are any questions or concerns, do not hesitate to discuss them with me.

Academic Integrity:
All graded work, including homework assignments, is expected to be your own. Failure to observe this rule will result in action by the office of *Student Judicial Affairs* and may result in a failing grade for the course.

Course Objectives: At the end of this course, you should be able to.. .

1. Convert an problem description written in English into a precise mathematical probabilistic statement,
2. Use the general properties of random variables to solve a probabilistic problem,
3. Maintain a set of standard probability distribution functions suitable for engineering applications,
4. Be able to calculate standard statistics from mass, distribution and density functions,
5. Apply basic sampling theory to calculate confidence intervals and perform statistical tests for population means,
6. Recognize and interpret a variety of random processes that occur in engineering
7. Calculate the autocorrelation and spectral density of an arbitrary random process
8. Understand stochastic phenomena such as white, pink and black noise
9. Relate the cor relation of and between input and output of autocorrelation and spectral density

How this course will be conducted:

i. This is a mathematically oriented engineering science course. As such, it will be conducted in a lecture/discussion format. In class we will do a number of examples (all of which are fair game for tests) and submit a series of problem sets.

ii. As a graduate student you will have different test than do the undergraduates. Three of the four problems will be the same, but the forth problem will be designed over the supplementary material that is studies by you as a graduate student.

ii. The course has two halves, the first being classical probability and mathematical statistics using random variables and the second half being random processes as applied to electrical engineering. Lots and lots of equations!

iv. As a graduate student, you will have supplementary work in the following areas:
   a. Bayesean statistics
   b. Multivariate statistics
   c. ARMA processes
   d. Signal sampling

Class Procedure:

i. There will be twelve homework assignments posted on the class website - uniformly spaced throughout the semester. Each of these should be done on your own and with care. In particular, each submission should have an appropriate cover page and each problem should be clearly stated and labeled. Use a separate page for each problem. Presentation quality is the order of the day.

ii. Solutions to all assignments will be published on the internet for your use in test preparation.

iii. It should be apparent that doing the assignments is important. In fact, a review of the grades given the last time that I taught this course 48 of 49 students were positively effected by doing the homework!

iv. If you don't wish to take homework ser iously (note the above items), please do not submit anything. It simply wastes both your time and mine. The purpose of homework is primarily for your feedback; I do not need it to assign a grade.

v. Tests will be announced well in advance and there is no provision made for make-up exams.

Course Description:

ECE 5810 is an introduction to probability, random variables, random processes, correlation functions and spectral density, pr imarily as they apply to signal processing in electrical engineering. Special consideration will be given to the stochastic signals, their corresponding response applied to linear systems. Roughly speaking we will cover the entirety of the text. Specific topics include.. .

- Probability
  - Probability theorems
  - **Bayesian statistics** (Augmented for graduate students)
  - Conditional probability
  - Bernoulli trials
- Random variables
  - Distribution, Mass and Density functions
  - Expectation operator
  - Operations on a single random variable
  - Uniform, Gaussian and Exponential distributions
- Multiple random variables
  - Joint distributions
  - Expectation and moments
  - **Correlation statistics** (Augmented for graduate students)
- Random processes
  - Statistical and time averages
  - Autocorrelation
  - Spectral density
  - Signal power
  - Qhite, pink and black noise models
  - (**ARMA processes** for graduate students)
- Linear systems
  - Crosscorrelation
  - Input/output correlation and spectral density relationships
  - Filter analysis
  - (**Nyquist's sampling theorem** for graduate students)