

Probabilistic Methods of Signal and Systems Analysis Course Syllabus

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Office Hours: Monday: 2:00 to 3:00 pm
~~Tuesday: 2:00 to 3:00 pm~~
Wednesday: 2:00 to 3:00 pm
~~Thursday: 2:00 to 3:00 pm~~
Friday: 2:00 to 3:00 pm

Prerequisites: ECE 310 is a must and CS 111 or ECE 2510 is helpful.

Materials:

- [we will be following this]: *Probabilistic Methods of Signal and System Analysis* (third edition) by George R. Cooper and Clare D. McGillem; Oxford Press.
- [required]: ECE 380 *Course Pac* by Frank L. Severance, which includes supplementary notes and problems. This is available through the student section of the IEEE.
- [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).

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. calculate confidence intervals for a population mean
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 correlation of and between input and output of autocorrelation and spectral density
10. design Weiner and matched noise filters

Grading: There will be nine assignments spaced evenly throughout the course. 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:

10 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.

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 you are expected to study primarily by doing a number of analogous exercises from the Course Pac.
- ii. The course has two halves, the first being classical probability and mathematical statistics and the second half being random processes as applied to electrical engineering. Lots and lots of equations!

Course Description:

ECE 380 is an introduction to probability, random variables, random processes, correlation functions and spectral density, primarily as they apply to signal processing in electrical engineering. Special consideration will be given to the stochastic signals, their corresponding response and the optimization of linear systems. Roughly speaking we will cover the entirety of the text. Specific topics include...

Probability

- probability theorems
- Bayesian statistics
- conditional probability
- Bernoulli trials

Random variables

- distribution, mass and density functions
- the expectation operator
- operations on a single random variable
- uniform, Gaussian and exponential distributions

Multiple random variables

- joint distributions
- expectation and moments
- correlation statistics

Random processes

- statistical and time averages
- autocorrelation
- spectral density
- power spectrums
- white, pink and black noise models

Linear systems

- crosscorrelation
- input/output correlation and spectral density relationships
- optimization
- matched and Wiener filters

Class Procedure:

- i. There will be nine homework assignments from the *ECE 380 Course Pac* 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. Answers to all assignments will be published. Also, solutions will be made available for your use in test preparation.
- iii. It should be apparent that doing the assignments is important. In fact, a review of last semester's final grades shows that the grades of 48 of 49 students was positively effected by doing the homework!
- iv. If you don't wish to take homework seriously, 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 give you a grade.
- v. Tests will be announced well in advance and there is no provision made for make-up exams.