EEL 5544 - Noise in Linear Systems  
(Should be called “Probability and Random Processes for Electrical Engineers”)

Dr. John M. Shea

Fall 2002

Pre-requisite: Solid understanding of systems theory, including convolution, Fourier transforms, and impulse functions. Elementary circuit theory, including transfer function concepts.

Computer requirement: **Some problems will require MATLAB.** Students may want to purchase the student version of MATLAB, as departmental computer resources are limited. Not being able to get on a computer is not a valid excuse for late work. Web access with the ability to run Java programs is also required.

Meeting Time: 10:40-11:30 Monday/Wednesday/Friday
Meeting Room: NEB 201
E-mail: jshea@ece.ufl.edu
Class Web page: [http://wireless.ece.ufl.edu/eel5544](http://wireless.ece.ufl.edu/eel5544)
Personal Web page: [http://wireless.ece.ufl.edu/jshea](http://wireless.ece.ufl.edu/jshea)
Office: 439 New Engineering Building
Phone: (352)846-3042
Office hours: 1:55-2:45 PM Monday and Wednesday


Other References:

Course Topics (as time allows)

- Sets and set operators, Venn diagrams
- Probability spaces and axioms of probability
- Combinatorial (counting) analysis
- Conditional probability, total probability and Baye’s rule
- Statistical independence
- Sequential experiments
- Single random variables and types of random variables
- Important random variables
- Distribution and density functions
- Functions of one random variable
- Expected value of a random variable
- Mean, variance, standard deviation, Nth moment, Nth central moment
- Markov and Chebyshev inequalities
- Transform methods: Characteristic and generating functions, Laplace transform
- Generating random variables
- Multiple random variables
- Joint and marginal distribution and density functions
- Functions of several random variables
- Joint moments and joint characteristic functions
- Conditional expected value
- Laws of large numbers and the central limit theorem
- Random processes
- Mean, autocorrelation, and autocovariance functions
- Stationarity
- Time-invariant filtering of random processes
- Power spectral density
- Matched filters and Weiner optimum systems
- Markov chains
- Examples of practical applications of the theory
Goals and Objectives: Upon completion of this course, the student should be able to

- Recite the axioms of probability; use the axioms and their corrolaries to give reasonable answers
- Draw Venn diagrams to illustrate set operations
- Determine probabilities based on counting (lottery tickets, etc.)
- Calculate probabilities of events from the density or distribution functions for random variables
- Classify random variables based on their density or distribution functions
- Know the density and distribution functions for common random variables
- Determine random variables from definitions based on the underlying probability space
- Determine the density and distribution functions for functions of random variables using several different techniques presented in class
- Calculate expected values for random variables
- Determine whether events, random variables, or random processes are statistically independent
- Use inequalities to find bounds for probabilities that might otherwise be difficult to evaluate
- Use transform methods to simplify solving some problems that would otherwise be difficult
- Evaluate probabilities involving multiple random variables or functions of multiple random variables
- Classify random processes based on their time support and value support
- Simulate random variables and random processes
- Classify random processes based on stationarity
- Evaluate the mean, autocovariance, and autocorrelation functions for random processes at the output of a linear filter
- Evaluate the power spectral density for wide-sense stationary random processes
- Give the matched filter solution for a simple signal transmitted in additive white Gaussian noise
- Determine the steady state probabilities for a Markov chain

Grading: Grading will be based on two midterm exams (25% each), one final exam (30%), homework (15%), and participation (5%). The participation score will take into account in-class participation, postings to the course’s electronic bulletin board, e-mail exchanges, discussions outside of class, etc. A grade of > 90% is guaranteed an A, > 80% is guaranteed a B, etc. Homework will be accepted late up to two times, with an automatic 25% reduction
in grade. Course grades will be primarily based on exams, homework, and unannounced quizzes. Bonus points will be awarded on some exams and for class participation. No formal project is required, but, as mention above, students will be required to use MATLAB in solving some homework problems. When students request that a submission (test or homework) be regraded, I reserve the right to regrade the entire submission rather than just a single problem.

Attendance: Attendance is not mandatory. However, students are expected to know all material covered in class, even if it is not in the book. Furthermore, the instructor reserves the right to give unannounced “pop” quizzes with no make-up option. Students who miss such quizzes will receive zeros for that grade. Bonus points will be awarded for class participation. If an exam must be missed, the student must see the instructor and make arrangements in advance unless an emergency makes this impossible. Approval for make-up exams is much more likely if the student is willing to take the exam early.

Academic Honesty:

All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action.

This statement is a reminder to uphold your obligation as a student at the University of Florida and to be honest in all work submitted and exams taken in this class and all others.

Honor statements on tests must be signed in order to receive any credit for that test.

I understand that many of you will have access to at least some of the homework solutions. Time constraints prohibit me from developing completely new sets of homework problems each semester. Therefore, I can only tell you that homework problems exist for your benefit. It is dishonest to turn in work that is not your own. In creating your homework solution, you should not use the homework solution that I created in a previous year or someone else’s homework solution. If I suspect that too many people are turning in work that is not their own, then I will completely remove homework from the course grade.

Collaboration on homework is permitted unless explicitly prohibited, provided that:

1. Collaboration is restricted to students currently in this course.
2. Collaboration must be a shared effort.
3. Each student must write up his/her homework independently.
4. On problems involving MATLAB programs, each student should write their own program. Students may discuss the implementations of the program, but students should not work as a group in writing the programs.

I have a zero-tolerance policy for cheating in this class. If you talk to anyone other than me during an exam, I will give you a zero. If you plagiarize (copy someone else’s words) or otherwise copy someone else’s work, I will give you a failing grade for the class.
Furthermore, I will be forced to bring academic dishonesty charges against anyone who violates the Honor Code.