University of Massachusetts
Department of Electrical and Computer Engineering

ECE 603 - Probability and Random Processes
Fall, 2016

URL: http://www-unix.ecs.umass.edu/∼dgoeckel/ece603.html

We see . . . that the theory of probabilities is at bottom only common sense reduced to calculation; it makes us appreciate with exactitude what reasonable minds feel by a sort of instinct, often without being able to account it . . .. It is remarkable that [this] science, which originated in the consideration of games of chance, should have become the most important object of human knowledge.

P. Laplace (1749-1827)

Objective: The objective of this course is to study the fundamentals of probability theory, random variables, and random processes at a level appropriate to support graduate coursework and research in electrical and computer engineering. Applications of the theory to engineering and the science problems will be emphasized, and random processes arising often in practical systems will be studied.

Course Format: Three 50-minute lectures (MWF 9:05, Place: ELAB 304)

Instructor: Prof. Dennis Goeckel, 215L Marcus Hall, Phone: 545-3514, e-mail: goeckel@ecs.umass.edu
Office Hours: Monday, 12:30-1:30 p.m.; Wednesday, 11:20-12:20 p.m.; or by e-mail

Teaching Assistant (TA): Shermin Hamzehei
Office Hours (in Marcus Hall 5): Tuesday, 3:00-5:00 p.m.; Thursday, 3:00-5:00 p.m.

Prerequisite: Some background in probability (equivalent to a standard ECE undergraduate course), Fourier analysis, and linear systems.

Textbook: None required. Optional texts will be discussed in class.

Grading: Homework - 15 %
Midterm Exam 1 (Date: October 19, 7-9pm, Place: Integrated Learning Center (ILC), S240) - 25 %
Midterm Exam 2 (Date: November 16, 7-9pm, Place: Integrated Learning Center (ILC), S240) - 25 %
Final Exam (Date: December 21, Time: 8-10am, Place: ELAB 304) - 35 %

All exams will be closed-book closed-notes, and **no** calculators will be allowed; however, a single **handwritten** formula sheet will be allowed. The final exam will be cumulative. Homeworks will be collected at the beginning of the lecture on the date (generally Fridays) that they are due. Homeworks will not be accepted after their solutions are distributed.

Ground Rules: You are allowed to work together on homeworks; however, each student must submit his own solutions. Also recall that homeworks are really only preparation for the exams, so do not rely too heavily on other students for help. **Academic dishonesty** (either taking or giving answers, use of extra crib sheets, etc.) on an exam will be dealt with harshly; you will receive an "F" for the course, and there may be further disciplinary action.

Course Outline (Subject to Modification)

I. Preliminaries

Functions, sets and their cardinality - countable versus uncountable, basic ideas of measure.

II. Elementary Probability

Probability space: sample space, events, and probability, counting, conditional probability, total probability and Bayes theorem, independence.

III. Random Variables

Distribution and density functions, expectation, multiple random variables, conditional distribution and density functions, independence, functions of random variables, densities and distribution examples for common random variables, introduction to estimation and detection.

IV. Convergence and Limit Theorems

Convergence of sequences of random variables, laws of large numbers, central limit theorem.

V. Stochastic Processes

Basic definitions, finite-dimensional distributions, stationarity (strict sense), autocorrelation function, power spectral density, wide-sense stationarity, filtering of random processes, ergodicity, discrete-time random processes and systems.

VI. Special Random Processes

Gaussian processes, independent increment processes, the Wiener process, Markov processes, Markov chains, Poisson processes.