

## Syllabus

### ECE 528: Introduction to Random Processes in ECE

**Course Number: ECE 528**

Prerequisites: ECE 220 and STAT 346 (all with grade of C or better), or permission of instructor.

**Instructor:** Bijan Jabbari, Professor

**Semester:** Fall 2021

**Lecture Time and Location:** Monday 4:30-7:10 pm, Planetary Hall 124

**Office:** Eng. Bldg. Room 3232

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**Office hours:** TBD

**Teaching Assistant:** TBD

**Recitation Time:** TBD

**Office hours:** TBD

**Administrative Assistant:** N/A

**Course Description**

Probability and random processes are fundamental to communications, control, signal processing, and computer networks. Provides basic theory and important applications. Topics include probability concepts and axioms; stationarity and ergodicity; random variables and their functions; vectors; expectation and variance; conditional expectation; moment-generating and characteristic functions; random processes such as white noise and Gaussian; autocorrelation and power spectral density; linear filtering of random processes, and basic ideas of estimation and detection.

**Course Outline**

- Probability Models in ECE
- Review of probability: set theory, basic concepts, probability spaces, conditional probability, Bayes' Rule, independence, Borel Fields, Generation of random numbers
- Discrete Random Variables: Notion of Random Variables, Probability Mass Functions (PMF), Expected Value and Moments, Important Discrete Random Variables, Generation of Discrete Random Variables
- General Random Variables (Single Variable): Cumulative Distribution Functions (CDF), Probability Density Functions (PDF), functions of random variables, expectations and characteristic function, Markov and Chebyshev inequalities
- Pairs of Random Variables: joint and marginal distributions, conditional distributions and independence, functions of two random variables, Expectations and correlations, pairs

of jointly Gaussian Random Variables, generating jointly Gaussian Random Variables

- Random vectors: Functions of several random variables expected value of vector random variables, jointly Gaussian Random vectors, convergence of random sequences
- Sums of random variables and long-term averages: the sample mean and the Laws of Large Numbers, the Central Limit Theorem
- Stochastic Processes: Basic concepts, Covariance, correlation, and stationarity, Gaussian processes and Brownian motion, Poisson and related processes, Power spectral density, Stochastic processes and linear systems
- Markov Processes and Markov Chains

**Textbook and References:**

- **Required Textbook:** Probability, Statistics, and Random Processes for Electrical Engineering , 3<sup>rd</sup> Edition, by Alberto Leon-Garcia, Pearson Prentice Hall, 2008.
- D. P. Bertsekas and J. N. Tsitsiklis, Introduction to Probability. Athena Scientific, Belmont, MA, 2nd Edition, 2008. See <http://www.athenasc.com/probbook.html>

**Grading:**

There will be weekly assignments, one Mid-term exam, and a Final exam. They will count towards the grade as follows:

- Homework and MATLAB Projects 20%
- Mid-term 35% (mid October)
- Final Exam 45% (up to 2 hours and 30 minutes) – see the schedule of Final Exams