

EE 550 - Random Processes

Fall 2022-2023
Course Information

Lecturer	: Hüseyin Özkan, huseyin.ozkan@sabanciuniv.edu Room: FENS 1107, Phone: x9594.
Textbook	: Alberto Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, Pearson Prentice Hall, Third Edition.
Lecture Hours	: Monday 13:40-15:30 (FENS G015), Tuesday 13:40-14:30 (FENS G025).
Office Hours	: By appointment (please drop me an email to arrange one).
Course Objectives	: To provide the fundamentals of random processes and a grasp of the most recent developments in research.
Prerequisite	: Probability, linear algebra, and programming. An introductory signal processing course is a plus, though not required.
Grading Policy	: Midterms, 60%; Paper presentations, 15%; Final, 25%.

Topics and Schedule (tentative):

- Part 1: Probability (**6 weeks**)

- Fundamentals

- Discrete and continuous random variables

- Scalar case, joint distributions and random vectors

- Simulations

- Transformations

- Basic detection and estimation

- Analysis: Theorems and inequalities

- Examples (throughout the exposition)

- Sample problem sets

- Midterm 1, week 4. (**Grading: 60/4 points**)

- Midterm 2, week 7. (**Grading: 60/4 points**)

- Part 2: Random Processes (**3 weeks**)

- Definitions

- Functions of mean, variance, correlation coefficient, autocorrelation, autocovariance, cross correlation / covariance

- Sum process, Binomial counting process and random walk

- Stationarity

- Time averages and ergodicity

- Examples (throughout the exposition)

- Sample problem set

- Midterm 3, week 10. (**Grading: 60/4 points**)

- Part 3: Analysis and processing of random signals (**4 weeks**)
 - Power spectral density
 - Response of linear systems to random signals
 - Optimum linear systems
 - Kalman filter
 - Examples (throughout the exposition)
 - Sample problem set
 - Midterm 4, week 14. (**Grading: 60/4 points**)
- Part 4: Markov Chains (**1 week**)
 - Stationary distributions
 - Balance equations
 - Birth-death process
 - Generalizations
 - Sample problem set
 - Final, week 15. (**Grading: 25 points**)
- Paper presentation: An in-class paper presentation and a brief (1-2 pages) report are required. You are expected to choose a journal article (about random processes) of interest to you published in the past three years. Approval of the instructor is required for the article chosen. Your presentation shall include: the problem description, data, why it is worth solving that problem in comparison to the related work in the literature, method, performance metrics, and results. Each presentation will be limited to 20 minutes. Exceeding minutes will be deducted your final grade from the course. (**Grading: 15 points**)

Notes:

- This is a tough course involving advanced probability.
- Sample problem sets will not be graded.
- Each midterm and final will include 4 problems, two of which will be from the problem sets.
- Your final course grade must be at least 50 to guarantee at least the letter grade of **C**. Please note that the letter grade of C- or lower will require the graduate students to repeat the course. Dropping below 25 will receive the failing grade of **F**.
- We use SUCourse+ as the communication medium throughout the course. Anything posted on SUCourse+ is assumed to be instantly known by everyone in the class!