

Department of Electrical and Computer Engineering
ECE 321: Random Signals and Noise

ECE 321: Random Signals and Noise (3-0-3)

Instructor: Dr. Hongya Ge

Textbook: Peyton Z. Peebles Jr., *Probability, Random Variables and Random Signal Principles*, McGraw Hill, 4th Ed., 2001 (reference).

Catalog Course Description: Random processes occurring in electrical engineering. An introduction to probability and random variables is followed by stochastic processes and noise. Topics include auto- and cross-correlation functions, power spectral density, response of linear systems to random signals, and noise figure calculations.

Course Description:

The course introduces basic concepts, and provides the basic definitions and mathematical tools that enable elementary analysis of random phenomena.

Key topics include:

- Introduction to probability theory
- Random Variables, distributions and density functions
- Operations on random variables (single, pairs, multiple)
- Random sums and sequences
- Random processes
- Linear Systems with random inputs

Prerequisite: ECE232 (Circuits and Systems II)

Corequisite: ECE333 (Systems and Signals)

Specific Course Learning Outcomes (CLOs):

The students will be able

1. to define, classify, manipulate, and calculate the basic characteristics of random variables and random processes
2. to analyze the characteristics and implications of data consisting of random sums and sequences
3. to develop simulations with the requisite statistical analysis
4. to relate behaviors of models of engineering systems to basic concepts and characteristics of random variable and random process models of data and outputs

Relevant Student Outcomes (ABET criterion 3):

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (CLO 1-4)
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (CLO 1-4)
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (CLO 1-4)

7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies (CLO 1-4)

Computer assisted design and course specific software: MATLAB

Topics:

Week	Topics	Chapter	Pages
1	Set, Sample Space, Joint and Conditional Probability	1	1-23
2	Bernoulli Trials, Random Variables, Density Functions, and Gaussian Random Variables	1-2	28-31 41-54
3	Binomial, Exponential, Rayleigh Distributions and Conditional Distributions	2	54-63
4	Expectation, Central Moment, Variance, and Characteristic Functions	3	77-87
5	Transformation of a Random Variable, Vector Random Variable, Joint Distribution Function	3-4	87-92 107-112
6	Marginal Distribution and Density Functions- Exam #1	4	112-116
7	Statistical Independence Distribution. Expectation of a Function of Random Variables	4-5	121-125 141-146
8	Jointly Gaussian Random Variables. Random Processes	5-6	148-151 179-188
9	Stationary Random Processes, Correlation Functions, Gaussian Random Process	6	188-206
10	Power Density Spectrum- Exam #2	7	220-225
11	Bandwidth of Power Density Spectrum. Auto-Correlation Function	7	225-234
12	White Noise, Linear Systems	7-8	246-251 270-275
13	Random Signal Response of Linear Systems	8	276-286
14	Review		
15	Final Examination		

Grading: Class participation, Homework, quizzes 10%; Mid-term examinations 2 x 30%; Final Examination 30%.

Discussing homework problem solutions in a group is beneficial, but the solution should be written independently, as it prepares you better for the examinations. Only one late homework assignment will be accepted during the semester. Homework assignments will be provided in class, through email or Moodle.

Honor Code: The NJIT Honor Code will be upheld, and any violations will be brought to the immediate attention of the Dean of Students.

Office: ECEC 311

Office hours: T 1:00 PM –2:00 PM
 W 11:30 AM – 12:30 PM
 R 12:00 PM – 2:00 PM

Other times can be arranged through appointments

Prepared by: M. Feknous/Kam