

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

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

Instructor: M. Feknous; email: feknous@njit.edu; Tel: 973-596-6460

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

Course Description:

Emphasis will be placed on basic concepts, fundamental principles, thinking and reasoning probabilistically, and "tricks of the trade".

Topics will include: basic set and probability theory; random variables and their functions; probability mass/density function, characteristic function and statistical moments of random variables; random processes and sequences of random variables; central limit theorem; properties of commonly encountered random processes; correlation and spectral analysis; linear systems with random inputs.

Application examples in electrical engineering will be presented.

Prerequisite: ECE232 (Circuits and Systems II), ECE333 (Systems and Signals)

Corequisite: none

Specific Course Learning Outcomes (CLOs): The students are able

1. to build up important scientific and engineering concepts involving random variables, system uncertainties, and model errors in many engineering fields,
2. to master the skills of thinking and reasoning in stochastic way for formulation and solving many problems in electrical and computer engineering involving uncertainties, and
3. to establish the foundation to understand advanced topics in communications and information systems as well as general engineering.

Relevant Student Outcomes (ABET criterion 3):

- (a) an ability to apply knowledge of mathematics, science, and engineering (CLO 1, 2, 3)
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data with measurement noise and errors (CLO 1, 2, 3)
- (c) an ability to design a system, component, or process to meet desired reliability needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (CLO 3)
- (d) an understanding of professional and ethical responsibility (CLO 3)
- (e) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context (CLO 3)
- (f) a recognition of the need for, and an ability to engage in life-long learning (CLO 3)
- (j) a knowledge of contemporary issues (CLO 3)
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (CLO 3).

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