New Jersey Institute of Technology
Department of Electrical and Computer Engineering

ECE 321 Random Signals & Noise (Fall 2025)
(Attendance Mandatory)

Description: The concepts of randomness, fundamentals of random signals and statistical signal processing are introduced in this course. The probability theory is presented and engineering applications dealing with random signals are highlighted. The mathematical methods and tools to represent random signals and randomness are thoroughly discussed to build the theoretical basis widely used to handle natural phenomena and real-world problems. The ***MATLAB*** use is a ***requirement*** for the course project and some HWs. ***Students are required to download the Statistics and Machine Learning Toolbox and practice with the available examples***, in particular the first three subjects, given at the link https://www.mathworks.com/help/stats/index.html .

Instructor: Prof. Ali N. Akansu, ECE Dept. [Akansu@NJIT.EDU, X5650] http://web.njit.edu/~akansu/

Time: Wednesday, 6:00-8:50PM, KUPF 211

Office Hour: Thursday, 4:30-5:30PM, ZOOM

Course Book:
Peyton Z. Peebles, *Probability, Random Variables and Random Signal Principles*. 4th Edition, McGraw Hill, 2001.

Supplementary Course Material:

MATLAB Student Edition.
Course notes whenever needed.
Relevant articles for self-study.

Topics:

Weeks 1 & 2: Probability, Joint & Conditional Probability, Independent Events, Combined Experiments, Bernoulli Trials (Ch. 1)

Weeks 3 & 4: The Random Variable (RV), Probability Distribution Function (PDF), Probability Density Function (pdf), Gaussian RV, other pdf types, Conditional Distribution and Density Function (Ch. 2)

Week 5: Operations on One random variable, Expectation, Moments, Moment Functions, Transformation of a RV (Ch. 3)

Week 6: Multiple Random Variables, Statistical Independence, and Central Limit Theorem (Ch. 4)

Weeks 7 & 8: Quiz #1, Operations on Multiple Random Variables (Ch. 5)

Week 9: Random Processes, Stationarity and Statistical Independence, Correlation Functions (Ch. 6)

Week 10: Gaussian Random Processes, Poisson Random Process (Ch. 6)

Weeks 11 & 12: Quiz #2, Spectral Characteristic of Random Processes (Ch. 7)

Weeks 13: Linear Systems with Random Inputs (Ch. 8)

Week 14: Optimum Linear Systems, Maximization of Signal-to-Noise Ratio (SNR), Minimization of Mean Square Error (MSE), Wiener Filters (Ch. 9). Some applications (Ch. 10).

Course Assignments:

Course Project: MATLAB implementation of one real world problem using measured data samples and the concepts learned in the course. **Project submission is mandatory.**

Homework Assignments (From Peebles Book, 4th Ed.) HW submission is mandatory.

HW1: 1.1.1, 1.1.3, 1.1.6, 1.1.12, 1.3.3, 1.3.8, 1.3.10
HW2: 1.4.1, 1.4.12, 1.5.5, 1.7.8, 1.7.9, 1.7.12
HW3: 2.1.5, 2.1.6, 2.1.11, 2.2.1, 2.2.5
HW4: 2.3.2, 2.3.9, 2.3.10, 2.4.2, 2.4.5, 2.4.9
HW5: 3.1.15, 3.2.2, 3.1.11, 3.1.7
HW6: 3.2.9, 3.2.24, 3.2.26, 3.2.27, M 3.5.5, M 3.5.6
HW7: 4.5.1, 4.4.6, 5.1.6, 5.1.8, 5.1.9, M 5.7.4
HW8: 6.5.1, 6.6.2, 6.6.3, 6.6.4
HW9: 7.1.1, 7.1.2, 7.1.12, M 7.5.17
HW10: 8.1.1, 8.1.4, 8.1.11, 8.2.1, 8.2.16, M 8.7.17, M 8.8.12
HW11: 9.1.4., 9.1.5, 9.1.7, 9.1.20

Grading Policy: 2 Quizzes (25% each); Final (30%); HW Assignments (10%); Course Project (10%)

Quiz #1: October 15, 2025

Quiz #2: November 19, 2025

Final: TBD