The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2020/2021

Course: **Probability and Random Variables – 0953321 (3 Cr. – Required Course)**

Instructor: Dr. Yazid Khattabi
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Office Hours: Will be posted soon

Course website: http://elearning.ju.edu.jo/

Catalog description: Introduction to probability and random variables. Discrete random variables. Continuous random variables. The probability density function. The probability distribution function. Statistics of random variables. Random processes. Ergodicity and stationarity. Auto-correlation function. Power spectral density. Estimating the autocorrelation function and power spectral density from raw data. Input output relations of linear systems.

Prerequisites by course: **EE** **0953221** Signal Analysis & Systems (pre-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Calculus (integration and differentiation).
- Solving ordinary differential equations.
- Fourier series, Fourier transform and linear systems.

Textbook: **Probability, Random Variables, And Random Signal Principles by Peyton Z. Peebles Jr., McGraw-Hill, 4th Edition, 2000.**

References:

1. Probability, Random Variables and Stochastic Processes by Athanasios Papoulis and S. Unnikrishna Pillai, McGraw-Hill, 4th Edition, 2002.
2. Schaum's Outline of Probability, Random Variables, and Random Processes by Hwei P Hsu, McGraw-Hill Education, 3rd Edition, 2014.
3. Schaum's Outline of Probability and Statistics by John J. Schiller Jr., R. Alu Srinivasan and Murray R. Spiegel, McGraw-Hill Education, 4th Edition, 2013.
4. Introduction to Probability, Statistics, and Random Processes by Hossein Pishro-Nik, Kappa Research LLC, 1st edition, 2014.
5. Probability and Random Processes for Electrical and Computer Engineers
by Charles Therrien and Murali Tummala, CRC Press, 2nd Edition, 2011.

6. Probability and Statistics for Engineering and the Sciences by Jay L. Devore, Cengage Learning, 9th Edition, 2015.
7. Introduction to Probability by Joseph K. Blitzstein and Jessica Hwang, Chapman and Hall/CRC, 1st edition, 2014.
8. Probability: For the Enthusiastic Beginner by David J. Morin, Independent Publishing, 1st edition, 2016.

Schedule: 16 Weeks, 42 lectures (50 minutes each) plus exams.

Course goals: The overall objective is to introduce the student to the principles of probability, random variables, and stochastic processes, and to formulate engineering problems within the framework of probability theory.

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will:	[SO]
1. Be able to convert an engineering problem statement into a mathematical probabilistic statement.	[1]
2. Be able to utilize statistical principles and the properties of random variables to solve probabilistic problems.	[1]
3. Know how to calculate standard statistics such as mean, variance, mass, distribution and density functions.	[1]
4. Recognize, interpret and apply a variety of random processes that occur in engineering.	[1]
5. Be able to calculate the auto-correlation and spectral density of a random process and recognize the relationship between them.	[1]
6. Understand stochastic phenomena, such as white and colored noise.	[1]
7. Understand linear systems, and their output characteristics.	[1]

Course topics:	Hrs
1. Probability: Axiomatic definition, use of set concepts, conditional and joint probability, independence, Bays rule, total probability, Bernoulli trials, permutations and combinations.	5
2. Random Variables: Basic concepts, distribution function, density function, the Gaussian random variable, other distribution and density examples, conditional distribution and density functions, families of distributions.	7
3. Operations on one random variable: expectation, moments, functions that give moments, transformations of a random variable, computer generation of one random variable.	6
4. Multiple random variables: vector random variables, joint distribution and its properties, joint density and its properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem.	6
5. Operations on multiple random variables: expected value of a function of random variables, joint characteristic function, jointly Gaussian random variables, transformations of multiple random variables, linear transformation of Gaussian random variables, computer generation of multiple random variables.	5

6. Random processes: The random process concept, stationarity and independence, correlation functions, measurement of correlation functions, Gaussian random processes, Poisson random process. **5**

7. Spectral characteristics of random processes: Power density spectrum and its properties, relationship between power spectrum and auto-correlation function, cross-power density spectrum and its properties, relationship between cross-power spectrum and cross-correlation function, some noise definitions and other topics. **4**

8. Response of linear systems to random and deterministic processes: Input/output relations of linear systems. **4**

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessment & grading policy:

Assignments	0%	Quizzes	0%
First Exam	30%	Projects	0%
Midterm Exam	30%	Lab Reports	0%
Final Exam	40%	Presentation	0%
		Total	**100%**

Last Revised: March 2021