PROBABILTY THOERY AND STOCHASTIC PROCESS

III Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEC003	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Know the theoretical formulation of probability, random variables and stochastic processes.
II. Be Familiar with the basic concepts of the theory of random variables in continuous and discrete time domain and analyze various analytical properties such as statistical averages.
III. Understand the concept of stationary in random processes and study various properties such as autocorrelation, cross correlation and apply them for signal analysis.
IV. Relate time domain and frequency domain representations of random processes and model different scenarios of random environment in signal processing applications.

COURSE LEARNING OUTCOMES (CLOs):

1. Understand probabilities and be able to solve using an appropriate sample space
2. Remember different random variables and their properties.
3. Discuss various operations like expectations from probability density functions (pdfs) and probability distribution functions.
4. Remember Transformations of random variables.
5. Perform Likelihood ratio tests from pdfs for statistical engineering problems.
6. Understand Operations on multiple random variables like moments.
7. Calculate Mean and covariance functions for simple random variables.
8. Understand the Ergodic processes.
9. Understand Auto-correlation and cross correlation properties between two random variables.
10. Explain the concept of random process; differentiate between stochastic, stationary and ergodic processes.
11. Explain the concept of power spectral density and power density spectrum of a random process.
12. Apply the power density spectrum of a random process in system concepts.
13. Remember the Autocorrelation to stochastic process.
14. Remember the Autocorrelation to stochastic process.
15. Apply the Gaussian Noise to stochastic process.
16. Apply the concept of probability theory and random process to understand and analyze real time applications.
17. Acquire the knowledge and develop capability to succeed national and international level competitive examinations.

Unit-I	PROBABILITY AND RANDOM VARIABLE	Classes: 09

Introduction to probability through sets and probability: Relative frequency; Experiments and sample spaces, discrete and continuous sample spaces; Events; Probability definitions and axioms; Mathematical model of experiments; Probability as a relative frequency; Joint probability; Conditional probability, total probability; Baye's theorem and independent events. Random variable: Definition of random variable, conditions for a function to be a random variable, discrete, continuous and mixed random variable.

Unit -II	DISTRIBUTION AND DENSITY FUNCTIONS	Classes: 09

Distribution and density functions: Distribution and density functions definitions and properties; Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional distribution, methods of defining conditioning on an event, conditional density, properties. Operation on one random variable expectations: Introduction, expected value of a random variable, function of a random variable, moments about the origin, central moments, variance and skew; Chebyche's inequality; Characteristic function; Moment generating function; Transformations of a random variable: Monotonic transformations for a continuous random variable; Non monotonic transformations of continuous random variable; Transformation of a discrete random variable.

Unit -III	MULTIPLE RANDOM VARIABLES AND OPERATIONS	Classes: 09

Multiple random variables: Vector random variables, joint distribution function, properties of joint distribution; Marginal distribution functions, conditional distribution and density: Point conditioning, conditional distribution and density: Interval conditioning, statistical independence, sum of two random variables, sum of several random variables; Central limit theorem.

Operations on multiple random variables: Expected value of functions of random variables: Joint moments about the origin, joint central moments, joint characteristic functions and jointly Gaussian random variables: Two random variables case and N random variable case, properties; Transformations of multiple random variables; Linear transformations of Gaussian random variables

Unit -IV	STOCHASTIC PROCESSES: TEMPORAL CHARACTERISTICS	Classes: 09

The random process concept, classification of processes, deterministic and non deterministic processes, distribution and density functions, concept of stationary and statistical independence; First order stationary processes; Second order and wide sense stationary, N Order and strict sense stationary, time averages and periodicity, mean Ergodic processes, correlation Ergodic processes; Autocorrelation function and its properties; Cross correlation function and its properties; Covariance functions; Gaussian random processes; Poisson random process.

Unit -V	STOCHASTIC PROCESSES: SPECTRAL CHARACTERISTICS	Classes: 09

Power spectrum: Properties, relationship between power spectrum and autocorrelation function; The cross power density spectrum, properties, relationship between cross power spectrum and cross correlation function. Spectral characteristics of system response: Power density spectrum of response; cross-power density spectrums of input and output of a linear system. Introduction to white Gaussian noise process and its properties.

Text Books:

1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", Tata McGraw Hill, 4th Edition, 2001.
2. Scott Miller, Donald Childers, "Probability and random process", Elsevier, 2nd Edition, 2012.
3. S.P. Eugene Xavier, "Statistical Theory of Communication", New Age Publications, 1st Edition, 2003

Reference Books:

1. Athanasius Papoulis, S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", PHI, 4th Edition, 2002.
2. Henry Stark, John W. Woods, "Probability and Random Processes with Application to Signal Processing", Pearson Education, 3rd Edition, 2014.
3. George R. Cooper, Clave D. MC Gillem, "Probability Methods of Signal and System Analysis", Oxford, 3rd Edition, 1999.

Web References:

www.britannica.com/topic/probability-theory

1. www.math.uiuc.edu/~r-ash/BPT.html

2. https://www.ma.utexas.edu/users/gordanz/.../introduction_to_stochastic_processes.pdf
3. nptel.ac.in/courses/111102014/
4. http://vceece2k10.blogspot.in/p/semester-2-1.html

E-Text Books:

1.http://freecomputerbooks.com/mathProbabilityBooks.html
2.http://www.springer.com/in/book/9780387878584
3. http://www.e-booksdirectory.com/listing.php?category=15