PROBABILITY THEORY AND STOCHASTIC PROCESSES

III Semester: ECE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECB08	Core	3	1	0	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. Understand the random experiments, sample space and event probabilities.
II. Study the random variables, density and distribution functions, moments and transformation of random variables.
III. Understand the concept of random process and sample functions (signals)
IV. Explore the temporal and spectral characteristics of random processes.

COURSE LEARNING OUTCOMES:

1. Describe the basic concepts of the random experiments, event probabilities, joint and conditional probabilities- bayes theorem
2. Learn and understand the concept of random variables, continuous and discrete variables, the probability density functions (pdfs), probability distribution functions (pdfs), different random variables and their properties
3. Learn and understand the functions of a random variable, standard and central moments, and their physical significance
4. Understand the characteristic and moment generating functions; understand and apply the transformations on continuous and discrete random variables - expectations
5. Learn and understanding of vector random variables, joint, marginal and conditional distribution functions, joint, marginal and conditional density functions.
6. Learn and understand the conditional distribution and density functions: point and interval conditioning
7. State and explain the central limit theorem : sum of several random variables
8. Learn and understanding of functions of vector random variables, joint standard and central moments, joint characteristic functions
9. Learn and understanding of jointly gaussian random variables; and transformations of multiple random variables
10. Learn and understanding of random process, sample functions and time domain characteristics: stationary, independence and ergodicity
11. Contrasting of correlation and covariance functions, gaussian and poisson random processes
12. Distinguish between auto- and cross- power density spectra, properties, relationship between correlation functions and power density spectra
13. Understand and discuss the linear time invariant (lti) systems driven by random process, input-output spectral relations, white and colored noises

MODULE - I	PROBABILITY, RANDOM VARIABLES AND OPERATIONS ON RANDOM VARIABLES	Classes: 09
Random Experiments, Sample Spaces, Events, Probability, Axioms, Joint, Conditional and Total Probabilities, Bay's Theorem, Independent Events. Random Variables: Definition, Conditions for mapping function of a Random Variable, Types of Random Variable, Distribution and Density functions: Definition and Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, random variables, Methods of defining Conditioning Event, Conditional Distribution, Conditional Density and their Properties, Expected Value of a Random Variable, Function of a Random Variable, Standard and Central Moments, Variance and Skew, Chebychev's Inequality		
MODULE - II	**SINGLE RANDOM VARIABLE TRANSFORMATIONS - MULTIPLE RANDOM VARIABLES**	**Classes: 09**
Characteristic Function, Moment Generating Function, Monotonic and Non-monotonic Transformations of Single Random Variables (Continuous and Discrete), Vector Random Variables, Joint Distribution Function and its Properties, Marginal Distribution Functions, Joint Density Function and its Properties, Marginal Density Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – Interval conditioning, Statistical Independence, Sum of Two and more Random Variables, Central Limit Theorem: Equal and Unequal Distribution.		
MODULE - III	**OPERATIONS ON MULTIPLE RANDOM VARIABLES – EXPECTATIONS**	**Classes: 09**
PART:1 Expected value of a function of multiple random variables, Correlation and Covariance , Correlation Coefficient, Joint Moments about the origin, Joint Central moments, Joint characteristic function, Joint moment generating function **PART:2** Jointly Gaussian random variables: Two random variables case and N random variable case, Properties, Transformations of Multiple Random Variables, Jacobian Matrix, Linear Transformations of Gaussian Random Variables		
MODULE - IV	**RANDOM PROCESSES – TEMPORAL CHARACTERISTICS**	**Classes: 09**
Random Process: Definition and Classification, Distribution and Density Functions, Stationarity and Statistical Independence., First- Order, Second- Order , Wide-Sense Stationarities (N-Order) and Strict-Sense Stationarity, Time Averages and Ergodicity, Mean-Ergodic and Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions, Gaussian and Poisson Random Processes. Response of Linear Systems to Random Process input, Mean and MS value of System Response, Autocorrelation Function of Response, Cross- Correlation between Input and Output.		
MODULE - V	**RANDOM PROCESSES – SPECTRAL CHARACTERISTICS**	**Classes: 09**
Power Density Spectrum: Definition and Properties, Relationship between Power Density Spectrum and Autocorrelation Function, Cross Power Spectral Density: Definition and Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function, System Evaluation using Random Noise, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectra of Input and Output, Noise Bandwidth, White and Colored Noises		

Text Books:

1. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, TMH, 4th Edition, 2001

Reference Books:

1. Random Processes for Engineers-Bruce Hajck, Cambridge unipress, 2015
2. Probability, Random Variables and Stochastic Processes – Athanasios Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition, 2002.
3. Probability, Statistics & Random Processes-K .Murugesan, P. Guruswamy, Anuradha Agencies, 3rd Edition, 2003.
4. Signals, Systems & Communications - B.P. Lathi, B.S. Publications, 2003.

Web References:

1. www.britannica.com/topic/probability-theory
2. www.math.uiuc.edu/~r-ash/BPT.html
3. https://www.ma.utexas.edu/users/gordanz/.../introduction_to_stochastic_processes.pdf
4. nptel.ac.in/courses/111102014/
5. 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