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19EC214 PROBABILITY THEORY AND STOCHASTIC PROCESSES

Hours Per Week :

L	T	P	C
3	1	-	4

PREREQUISITE COURSE: Signals and Systems.

COURSE DESCRIPTION AND OBJECTIVES:

The objective of the course is to enable the students to learn probability theory and random variables, gain knowledge of multiple random variables, conditional expectation, independence of random variables, analysis of random process and applications in the communication systems.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes.

COs	Course Outcomes
1	Understand the basics of probability, sample space, events, statistics and apply them to real life problems
2	Distinguish probability density and distribution functions for single and multiple random variables.
3	Check whether a given random process is ergodic and/or wide sense stationary.
4	Analyze the response of linear systems to random inputs.

SKILLS:

- ✓ *Formulate, analyze and validate models applicable to practical problems.*
- ✓ *Use the probability, moment generating functions and characteristic functions.*
- ✓ *Know the multivariate normal law and how to operate jointly with Gaussian random variables.*
- ✓ *Identify the different modes of convergence of sequences of random variables as well as the precise meaning of the laws of large numbers and the central limit theorem.*
- ✓ *Identify probability models based on the theoretical results presented in the course.*

UNIT - I **L-8, T-3**

PROBABILITY THEORY AND PROBABILITY STATISTICS: Introduction to probability, Set theory, Axioms of probability, Sample space, Joint probability, Conditional probability, Total probability and Bayes' theorem, Bernoulli trails and independent events.

UNIT - II **L-10, T-3**

RANDOM VARIABLES: Definition of a random variable, Conditions for a function to be a random variable, Classifications of random variables, Density and distribution functions, Properties of random variables, Binomial, Poisson, Uniform, Gaussian, Exponential and Rayleigh distributions, Conditional distribution, Methods of defining conditioning event, Conditional density and distribution functions, Properties, Operations on random variables - introduction, expected value of a random variable, function of a random variable, moments about the origin, central moments, variance, chebychev's inequality, characteristic function, markov's and chernoff bound, moment generating function, monotonic transformations for a continuous and discrete random variables.

UNIT - III **L-9, T-3**

MULTIPLE RANDOM VARIABLES: Vector random variables, Joint distribution function and its properties, Marginal distribution functions, Conditional distribution and density, Statistical independence, Sum of two random variables, Central limit theorem, Multi-dimensional Gaussian random variables.

UNIT - IV **L-9, T-3**

RANDOM PROCESSES: Temporal characteristics, Random process concept, Classification of processes, Distribution and density functions, Concept of stationary and statistical independence, Wide sense stationary, Time averages and ergodicity, Autocorrelation and cross correlation, Covariance, Gaussian random processes, Poisson random process.

UNIT - V **L-9, T-3**

LINEAR SYSTEMS WITH RANDOM INPUTS: Random signal response of linear systems, System response - convolution, mean and mean square value, Autocorrelation function; Cross-correlation functions of input and output, Spectral characteristics of system response, Power density spectrum of response, Cross-power density spectrums of input and output.

TEXT BOOKS:

1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", 4th edition, TMH, 2001.
2. Athanasios Papoulis and Unni Krishna Pillai, "Probability, Random Variables and Stochastic Processes", 4th edition, TMH, 2002.

REFERENCE BOOKS:

1. H.Taub, Donald.L.Schilling, GoutamSaha, "Principles of Communication systems", 3rd edition, TMH, 2007.
2. Mallikarjuna Reddy, "Probability Theory and Stochastic Processes", 4th edition, University Press, 2013.
4. Henry Stark and John W.Woods, "Probability and Random Processes with Application to Signal Processing", 3rd edition, Prentice Hall Publications, 2002.
5. H. Kobayashi, B. L. Mark, and W. Turin, "Probability, Random Processes, and Statistical Analysis", 1st edition, Cambridge University Press, 2012.
6. R. Gallager, "Stochastic Processes: Theory for Applications", 1st edition, Cambridge University Press, 2013.