16EC206 PROBABILITY THEORY AND STOCHASTIC PROCESSES

Hours Per Week :

L	T	P	C
3	1	-	4

Course Description and Objectives:

This course deals with the quantifying of randomly varying parameters that are prevalent in real life situations. The objective of the course is to enable the student to learn probability theory and random variables, gain knowledge of multiple random variables, conditional expectation, independence of random variables, analysis of random processes and applications in the communication systems.

Course outcomes:

Upon successful completion of this course, students should be able to:

CO1: Understands the basics of probability, sample space, events, statistics and apply them to real life problems.

CO2: Distinguish probability density and distribution functions for single and multiple random variables.

CO3: Calculate the statistical parameters for random variables.

CO4: Analyze the concept of random process along with its parameters.

CO5: Estimate the correlation, covariance and PSD for random processes.

CO6: 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 - 1 **L-9,T-3**

PROBABILITY THEORY AND PROBABILITY STATISTICS: Mean, Median, Mode and Standard deviation, Correlation and regression analysis, Introduction to probability, Joint probability, Conditional probability, Total probability, Bayes' theorem, Bernoulli trails and independent events.

UNIT - 2 **L-9,T-3**

THE RANDOM VARIABLE AND OPERATIONS ON 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, Rayleigh, 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, Moment generating function, Monotonic transformations for a continuous and discrete random variables.

UNIT - 3 **L-8,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.

UNIT - 4 **L-8,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 function and its properties, Cross correlation function and its properties, Gaussian random processes, Poisson random process, Relation between power spectral density and autocorrelation.

UNIT - 5 **L-11,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, Modeling of noise sources - Resistive (thermal) noise source, Arbitrary noise sources, Effective noise temperature, Average noise figures, Average noise figure of cascaded networks.

TEXT BOOKS:

1. Peyton Z. Peebles, "Probability, Random Variables and Random Signal Principles", 4th edition, Tata McGraw-Hill, 2001.
2. Athanasios Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes", 4th edition, PHI, 2002.

REFERENCE BOOKS:

1. R.P. Singh and S.D. Sapre, "Communication Systems Analog and Digital", 2nd edition, Tata McGraw Hill, 2009.
2. Henry Stark and John W. Woods, "Probability and Random Processes with Application to Signal Processing", 3rd edition, Pearson Education, 2009.
3. S.P. Eugene Xavier, "Statistical Theory of Communication",1st edition, New Age Publications, 2003.
4. George R. Cooper and Clave D. MC Gillem, "Probability Methods of Signal and System analysis" 3rd edition, Oxford, 1999.
5. Y.Mallikarjuna Reddy, "Probability Theory and Stochastic Process" 4th edition, Universities press, 2015.

ACTIVITIES:

- *Verify that sum of two random variables is Gaussian.*
- *Write MATLAB code for finding total probability.*
- *Find Expectation, variance and standard deviation with the help of MATLAB for*

  (a) any random data.

  (b) any continuous random variables.

  (c) any discrete random variables.
- *Find Auto Correlation Function and Cross Correlation function for any two random variables.*
- *Plot density and distribution function for any random data.*