II Year II Semester	**L**	**T**	**P**	**C**
Code:20EC4007	**3**	**0**	**0**	**3**

PROBABILITY THEORY AND STOCHASTIC PROCESSES

Course Objectives:

1. To provide mathematical background of probability to solve probabilistic problems in signal processing and Communication Engineering.
2. To study the concept of random variable and operations on random variables.
3. To explain the concepts of multiple random variables and operations that may be performed on multiple random variables.
4. To understand the concepts of stochastic process and its temporal & spectral characteristics.
5. To know the concepts of Noise in Communication systems.

UNIT–I: Probability & Random Variable

Probability introduced through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Bay's Theorem, Independent Events.
Random Variable: Definition, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variable.

UNIT–II: Distribution & Density Functions and Operation on One Random Variable

Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Methods of defining Conditioning Event, Conditional Distribution, Conditional Density and their Properties
Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic and Non-monotonic Transformations of Continuous Random Variable, Transformation of a Discrete Random Variable.

UNIT–III: Multiple Random Variables and Operations

Multiple Random Variables: Joint Distribution and density Functions and their Properties, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density, Statistical Independence. Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem- Unequal Distribution, Equal Distributions.
Operations on Multiple Random Variables: Expected Value of a Function of Random Variables: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNIT–IV: Stochastic Processes

Temporal Characteristics: The Stochastic Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of

Stationarity and Statistical independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, N^{th}-order and Strict-Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process

Spectral Characteristics: Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, Cross-Power Density Spectrum, Properties.

UNIT–V: Noise Sources

Introduction, Classification, White noise or White Gaussian noise, Resistive/Thermal Noise Source, Arbitrary Noise Sources, Effective Noise Temperature, Noise equivalent bandwidth, Average Noise Figures, Average Noise Figure of cascaded networks, Narrow band noise and its properties

Course Outcomes:

A student who successfully fulfils this course requirement will be able to:

S.No	Course Outcome	BTL
1.	Compute simple probabilities using an appropriate sample space.	L3
2.	Compute probabilities and expectations from probability density functions.	L3
3.	Translate one random variable to multiple random variables.	L2
4.	Determine the Spectral and temporal characteristics of Stochastic processes.	L3
5.	Understand the concepts of Noise in Communication systems.	L2

Correlation of COs with POs& PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	1	-	-	-	-	-	-	-	-	-	2	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	1	-

Text Books:

1. Probability, Random Variables & Random Signal Principles – Peyton Z. Peebles, Tata McGraw Hill, Fourth Edition, 2001.
2. Probability, Random Variables and Stochastic Processes – Athanasios Papoulis and S.Unnikrishnan, Prentice Hall of India, Fourth Edition, 2002.
3. Probability theory and stochastic process – Y. Mallikarjuna Reddy, Universities Press, Fourth edition.

Reference Books:

1. Probability Theory and Stochastic Processes – B. Prabhakara Rao, BS Publications.
2. Probability and Random Processes with Applications to Signal Processing – Henry Stark and John W. Woods, Pearson Education, Third Edition.
3. An Introduction to Random Signals and Communication Theory – B.P. Lathi, International Textbook, 1968.
4. Probability Theory and Random Processes – P. Ramesh Babu, Mc Graw Hill, 2015.