

MODULE - I

Chapter 1 : Basic Concepts in Probability 1-1 to 1-13

Syllabus : Definitions of probability, joint, conditional, and total probability, Bayes' theorem, independence of events, binary symmetric communication channel analysis using Bayes' theorem.

1.1 Basics of Probability 1-1

1.1.1 Mathematical Definition of Probability 1-1

1.1.2 Axioms of Probability..... 1-3

1.1.2(A) Properties of Probability 1-3

1.1.3 Conditional Probability 1-4

1.1.3(A) Properties of Conditional Probability 1-4

1.2 Independent Events 1-5

1.3 Partition of a Sample Space 1-6

1.3.1 Theorem of Total Probability 1-7

1.3.2 Bay's Theorem of Conditional Probability.... 1-7

**1.4 Binary Symmetric
Communication Channel 1-11**

MODULE - II

Chapter 2 : Introduction to Random Variables

2-1 to 2-22

Syllabus : Continuous, discrete, and mixed random variables, probability density function, probability distribution function, and probability mass function, properties of PDF and CDF. Special distributions - Binomial, Poisson, Uniform, Gaussian and Rayleigh Distributions Mean, variance and moments of random variables.

2.1 Random Variable 2-1

2.1.1 Discrete Random Variable 2-1

2.1.2 Continuous Random Variable 2-2

2.1.3 Mixed Random Variable 2-3

2.2 Cumulative Distribution Function (CDF) 2-3

2.2.1 Properties of Cumulative Distribution
Function (CDF) of random Variable X 2-3

2.3 Mathematical Expectation 2-9

2.3.1 Variance 2-10

2.3.2 Covariance 2-10

2.3.3 Moments 2-10

2.3.3(A) Raw Moments 2-11

2.3.3(B) Central Moments 2-11

2.4 Moment Generating Function 2-12

2.4.1 Properties of Moment
Generating Function 2-12

2.5 Special Probability Distribution 2-12

2.5.1 Binomial Distribution 2-13

2.5.2 Poisson Distribution 2-13

2.5.3 Normal Distribution / Gaussian
Distribution 2-18

2.5.4 Uniform Distribution 2-21

2.5.5 Rayleigh Distribution 2-22

MODULE - III

Chapter 3 : Operations on One Random Variable

3-1 to 3-47

Syllabus : Function of a random variable and their distribution and density functions. Expectation, variance, moments, and characteristic function of random variable. Transformation of a random variable, Markov and Chebyshev inequality, characteristic functions, moment theorem.

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3.1.1 Function of a Discrete Random Variable 3-1

3.1.2 The Random Variable X is Continuous but y is Discrete 3-2

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3.4.1 Mean and Variance of a Continuous Random Variable..... 3-9

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3.6 Properties of Variance 3-13

3.7 Moments of Higher Order 3-14

3.8 Moment Generating Function 3-16

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3.11.1(B) Case II : The Random Variable X is Continuous But Y is Discrete 3-24

3.11.1(C) Case III : X and Y Both Are Continuous Random Variables 3-25

3.11.1(D) Case IV : The Random Variable X is Continuous and Y = g(x) is Not Monotonic 3-27

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3.11.3 Two Function of Two Random Variables ... 3-32

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MODULE - IV

Chapter 4 : Multiple Random Variables and Convergence
4-1 to 4-27

Syllabus : Pairs of random variables, joint CDF and joint PDF. One function of two random variables; joint moments, covariance and correlation independent, uncorrelated and orthogonal random variables. Central limit theorem and its significance.

4.1 Introduction to Pairs of Random Variables 4-1

4.1.1 Distribution Function of a Two Dimensional Random Variable (X, Y)..... 4-1

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4.1.3 Properties of Joint Density Function 4-2

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4.3.2 Properties of Conditional Density Function 4-7

4.3.3 Independence of Random Variables 4-7

4.4 One Function of Two Random Variables 4-10

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4.6 Covariance and Correlation 4-15

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MODULE - V

Chapter 5 : Random Processes 5-1 to 5-32

Syllabus : Definitions, statistics of stochastic processes, nth order distribution, second-order properties : mean and autocorrelation, Poisson process, normal processes, SSS, WSS. Mean and correlation ergodic processes, transmission of WSS through LTI system, introduction to Markov process.

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MODULE - VI

**Chapter 6 : Introduction to Statistical Learning
and Applications 6-1 to 6-12**

Syllabus : Regression and model building, Simple linear regression, Multiple linear regression, Least square estimation of the coefficients, Residual calculations.
Applications of simple linear regression in prediction of new observations.

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6.1.1 Simple Linear Regression Model6-1

6.1.2 Multiple Regression Model.....6-3

6.1.3 Least Square Estimation of the
Coefficients (Parameters).....6-3

**6.2 Applications of Simple Linear
Regression 6-9**

