19MAT205 Probability & Random Processes

Course objectives:

- To understand the concepts of basic probability and random variables.
- To understand some standard distributions and apply to some problems.
- To understand the concepts of random process, stationarity and autocorrelation functions.
- To understand Markov process and Markov chain and related concepts.

Course Outcomes:

- CO1: Understand the basic concepts of probability and probability modeling.
- CO2: Gain knowledge about statistical distributions of one and two dimensional random variables and correlations
- CO3: Understand the basic concepts of stochastic processes and the stationarity.
- CO4: Understand the purpose of some special processes
- CO5: Gain knowledge about spectrum estimation and spectral density function

Syllabus:

Module I: Review of probability concepts - conditional probability- Bayes' theorem. Random Variable and Distributions: Introduction to random variable – discrete and continuous random variables and its distribution functions- mathematical expectations – moment generating function and characteristic function.

Module II: Binomial, Poisson, Geometric, Uniform, Exponential, Normal distribution functions (moment generating function, mean, variance and simple problems) – Chebyshev's theorem.

Module III: Stochastic Processes: General concepts and definitions - stationary in random processes - strict sense and wide sense stationary processes - autocorrelation and properties- special processes – Poisson points, Poisson and Gaussian processes and propertiessystems with stochastic inputs - power spectrum-spectrum estimation, ergodicity –Markov process and Markov chain, transition probabilities, Chapman Kolmogrov theorem, limiting distributions classification of states. Markov decision process.

Text Book(s):

1. Douglas C. Montgomery and George C. Runger, *Applied Statistics and Probability for Engineers*, (2005) John Wiley and Sons Inc.
2. A. Papoulis, and Unnikrishna Pillai, "*Probability, Random Variables and Stochastic Processes*", Fourth Edition, McGraw Hill, 2002.

Reference Book(s)

1. J. Ravichandran, "*Probability and Random Processes for Engineers*", First Edition, IK International, 2015. Scott L. Miller, Donald G. Childers, "Probability and Random Processes", Academic press, 2012.

Lecture Plan: 19MAT205 Probability & Random Processes

Lecture No.	Topic
1	Introduction to Probability – Measures of probability – definitions
2	Theorems on probability (Addition, Multiplication and conditional)
3	Bayes Theorem – proof
4	Problems on probability and Bayes theorem
5	Introduction to random variables: Discrete and continuous random variables with examples
6	Probability mass function(PMF) and Probability density function (PDF) Cumulative distribution function (CDF)– properties
7	Problems on PMF/PDF/CDF
8	Problems on PMF/PDF/CDF
9	**Assignment/Quiz/Tutorial 1**
10	Mathematical Expectation – concept and properties
11	Variance and Standard deviation -simple problems
12	Moment generating function(MGF) –definition and properties
13	Binomial Distribution- MGF, mean and variance
14	Poisson Distribution- MGF, mean and variance
15	Simple Problems on the above distributions
16	Uniform Distribution- MGF, mean and variance
17	Exponential Distribution- MGF, mean and variance
	Periodical Test 1
18	Normal Distribution-MGF, mean and variance
19	Simple Problems on the above distributions
20	Two dimensional random variables – JPMF and JPDF
21	Marginal and conditional probability functions – Stochastic independence
22	Problems on JPMF and JPDF
23	Problems on JPMF and JPDF
24	Correlation– introduction to concepts
25	Correlation– examples based on JPMF/JPDF
26	**Assignment/Quiz/Tutorial 2**
27	Chebyshev's theorem- proof for continuous case
28	Problems on Chebyshev's Theorem
29	Central limit theorem (CLT – introduction to concept – theorems
30	Problems on Chebyshev's theorem and CLT
31	Random Processes – introduction
32	Classification – statistical properties – examples
33	Stationary processes – SSS/WSS processes
34	Examples on SSS/WSS processes
	Periodical Test 2
35	Properties of autocorrelation function – problems
36	Examples on WSS/Variance
37	Point process-Poisson process – concepts – properties

38	Mean-autocorrelation of Poisson Process – proof
39	Theorems on Poisson Process
40	Problems on Poisson process
41	Gaussian Process- First and Second order Process
42	Properties - Problems
43	The spectrum estimation – concepts
44	Mean ergodic theorem,
45	Sufficient condition for Mean ergodicity - Problems
46	Correlation ergodicity Problems
47	Power spectral density (PSD) – concepts- properties
48	Weiner Kinchine theorem
49	Problems on PSD
50	**Assignment/Tutorial 3**
51	Markov Process – Chain – concepts
52	Chapman Kolmogorov theorem, steady state probabilities
53	Classification of states
54	Problems on Markov chain
55	Problems on Markov chain

Evaluation Pattern:

Assignment/Quiz/Tutorial (Internal) : 20 Marks

Periodical Test 1(Internal) : 15(Online exam: 5 Marks + VIVA: 10 Marks)

Periodical Test 2 (Internal) : 15(Online exam: 5 Marks + VIVA: 10 Marks)

End Semester (External) : 50(Online exam: 20 Marks + VIVA: 30 Marks)