MATHEMATICS

Core V **Semester III**

Probability

Course Objective:

The objective of the course is to make the student understand basics of probability which is of use in everyday life.

Learning Outcomes:

After completing the course the student will be able to

- Learn the basics of probability and random variables with axioms of probability.
- Know the discrete and continuous distributions and learn how to calculate mean, variance and moments of them.
- Learn on limit theorems with their applications and know about the conditional expectations.
- Learn on Markov chains and their applications.

Unit I

Sample space and events, probability axioms, probability defined on events, conditional probabilities, Independent events, Bayes formula, real random variables, discrete and continuous random variables, probability distribution function, probability mass/density functions, mathematical expectation, and properties, variance and standard deviation.

Unit II

Discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential, their expectations and variance, moments, moment generating function, characteristic function and computation of these for the distributions, joint distribution function and its properties, joint probability density functions, marginal and conditional distributions, independent random variables.

Unit III

Limit theorems: Markov inequality, Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, application to problems, conditional probability and conditional expectation, discrete case, continuous case,

applications, expectation of function of two random variables, conditional expectations, bivariate normal distribution, correlation coefficient, joint moment generating function and calculation of covariance, linear regression for two variables.

Unit IV

Central limit theorem for independent and identically distributed random variables with finite variance, Markov chains, Chapman-Kolmogorov equations, classification of states, Gambler Ruin problem.

Book Recommended

1. *Sheldon Ross, Introduction To Probability Models (9th Edition), Academic Press, Indian Reprint, 2007.*
2. *Robert V. Hogg, Joseph W. Mckean And Allen T. Craig, Introduction To Mathematical Statistics, Pearson Education, Asia, 2007.*
3. *Kai Lai Chung, Elementary Probability Theory With Stochastics Process, Springer International Students Edition, (Narosa Publ.)*

Book for Reference

- ✓ *Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, (3rd Edition), Tata McGraw- Hill, Reprint 2007.*
- ✓ *Chow Y S , Teicher H Probability theory Springer International edition*
- ✓ *Irwin Miller and Marylees Miller, John E. Freund's Mathematical Statistics with Applications (7th Edition), Pearson Education, Asia, 2006.*
- ✓ *e-Learning Source http://ndl.iitkgp.ac.in ; http://ocw.mit.edu ; http://mathforum.org*
- ✓ *Suggested digital platform: NPTEL/SWAYAM/MOOCs.*