Semester	**SIX**
Course	**Minor**
Paper Code	**B3ST230611T**
Paper Title	**Probability Theory and Sampling Distribution**
No. of Credits	**4**
Theory / Practical /Composite	**Theory**
Classes per week	**4**
Module	**1**

Course outcomes

1. **Remember** fundamental concepts of probability such as random experiments, sample space, events, axioms of probability, conditional probability, and standard probability distributions
2. **Understand** the logical structure of probability theory including laws of probability, Bayes' theorem, independence of events, and the properties of random variables and their distributions
3. **Apply** probability rules and distributional concepts to solve numerical problems involving discrete and continuous random variables, moments, and quantiles measures of central tendency, dispersion, skewness and kurtosis.
4. **Analyse** univariate and bivariate probability distributions, sampling distributions, and relationships between random variables using appropriate probabilistic tools
5. **Evaluate** suitable probability models and sampling distributions (χ^2, t, F) for given statistical situations and assess assumptions underlying their use
6. **Create** probabilistic and sampling-based models for real-life phenomena and interpret results for decision-making.

Syllabus

Unit/Module	Content	No. of lectures	CO mapping	Cognitive levels
Unit 1	Random experiments, sample space, events and algebra of events. Classical definition of probability, theorems regarding union and intersections of events, Boole's inequality and Bonferroni's inequality. Conditional probability and Bayes' Theorem. Independence of events. Frequency and Axiomatic definitions of probability.	18	CO1 CO2 CO3	K1 K2 K3
Unit 2	Random variable and its probability distribution, cumulative distribution		CO2 CO3 CO4	K2 K3 K4

	function, probability mass function, probability density function. Moment and quantile measures of central tendency, dispersion, skewness and kurtosis. Bivariate probability distribution.	13		
Unit 3	Concept of theoretical distributions. Binomial, Poisson, Hypergeometric, Geometric, Rectangular, Normal, Exponential, Bivariate Normal Distribution – properties and applications.	13	CO1 CO3 CO4 CO5	K1 K3 K4 K5
Unit 4	Population and Sample. Random Sample. Parameter and Statistic. Sampling fluctuations, sampling distribution and standard error. Sampling distributions arising out of normal population – $\chi 2$, t, F (definition and statement of properties). Distribution of sample mean, sample variance and their independence in case of normal population (statement only).	8	CO2 CO4 CO5 CO6	K2 K4 K5 K6

Reading/Reference list

1. A. M. Gun, M. K. Gupta and B. Dasgupta: *Fundamentals of Statistics (Volume One)*, The World Press Private Limited; 2005
2. Hogg RV, McKean JW, Craig AT. Introduction to mathematical statistics. Pearson Education India; 2013.
3. Ross SM. A first course in probability. Harlow, UK: Pearson; 2020.

Evaluation

	CIA: 30 Semester Exam:70	
Paper Structure for Semester Exam	Short Questions (5 Marks Each)	Long Questions (15 Marks Each)
	5 out of 7	3 out of 5

CO	CO Description	Cognitive levels
CO1	**Remember** fundamental concepts of probability such as random experiments, sample space, events, axioms of probability, conditional probability, and standard probability distributions	K1

CO2	**Understand** the logical structure of probability theory including laws of probability, Bayes' theorem, independence of events, and the properties of random variables and their distributions	K2
CO3	**Apply** probability rules and distributional concepts to solve numerical problems involving discrete and continuous random variables, moments, and quantiles measures of central tendency, dispersion, skewness and kurtosis.	K3
CO4	**Analyse** univariate and bivariate probability distributions, sampling distributions, and relationships between random variables using appropriate probabilistic tools	K4
CO5	**Evaluate** suitable probability models and sampling distributions (χ^2, t, F) for given statistical situations and assess assumptions underlying their use	K5
CO6	**Create** probabilistic and sampling-based models for real-life phenomena and interpret results for decision-making.	K6