Semester	**3**
Course	**Core**
Paper Code	**C2DS250321T**
Paper Title	**Probability Theory and Applications**
No. of Credits	**4**
Theory/Composite/ Practical	**Theory**
No. of Classes per Week	**4**
Minimum No. of preparatory hours per week a student has to devote	**4**
Number of Module	**1**
Syllabus	**Unit 1: Introduction [10L]** Permutation and combination. Sets and Venn diagrams. Random experiment, outcomes, sample space, events. Classical, statistical and axiomatic definitions of probability. Subjective probability. **Unit 2: Theorems on Probability and Applications [16L]** Poincare's theorem. Boole's and Bonferroni's inequality (applications). Probability of occurrence of at least m and exactly m events out of n events, n (n>m) being finite. Conditional Probability, multiplication law of probability, theorem of total probability. Bayes theorem and its applications. Independence and conditional independence. Real world applications of Probability. **Unit 3- Random variables and Probability distributions [6L]** Definition and illustrations of random variables. PMF, PDF, CDF (graphs and properties). Empirical distribution function. Moments and quantiles. Moment generating functions. Markov and Chebyshev's inequality. **Unit 4- Univariate discrete distributions [6L]** Uniform, Hypergeometric, Binomial, Poisson, Negative Binomial, Geometric distributions (genesis, properties and applications). **Unit 5- Univariate continuous distributions [6L]** Rectangular, Exponential, Gamma, Beta, Normal, Log normal, Cauchy, Pareto, Logistic, Double exponential, Pareto distributions (genesis, properties and applications). **Unit 6- Joint distribution of Bivariate random variables [8L]** Bivariate random vector. Mean, dispersion and correlation matrix. Distribution function, conditional & marginal distributions. Concept of bivariate copula. Independence of random variables. Bivariate normal distribution and its properties. Ideas of correlation and linear regression.
Learning Outcomes	o Recall the fundamental concepts of combinatorics and Venn diagrams o Understanding the concepts of random experiment and Probability o Applying Probability theorems to solve real life problems

	○ Evaluating the decision-making process using EMV ○ Understanding the concept of random variable and its probability distribution ○ Applying the properties of discrete distributions to solve probability problems. ○ Evaluating the appropriateness of using a specific continuous distribution in a given context or application. ○ Analysing problems involving bivariate random variables and their distributions.	
Reading/Reference List	1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi. 2. Ross, S. (2018): A First Course in Probability, 9th Edition, Pearson. 3. Bertsekas, D.P. & Tsitsiklis, J.N. (2008): Introduction to Probability, 2nd Athena Scientific. Nashua, NH. 4. K.L. Chung: Elementary Probability Theory with Stochastic Process. 5. https://www.coursera.org/learn/introductiontoprobability 6. https://www.udemy.com/topic/statistics/	
Evaluation	CIA: 30 Semester exam: 70 Total: 100	
Paper Structure for Theory Semester Exam	Short Questions (5 Marks each)	Long Questions (15 Marks each)
	5 out of 7	3 out of 5