Semester	**5**
Course	**Major**
Paper Code	C3MT230511T
Paper Title	**Probability Theory**
No. of Credits	**4**
Theory / Practical / Composite	**Theory**
Minimum No. of preparatory hours per week a student has to devote	**4**
Number of Modules	**Nil**
Syllabus	Interpretation of randomness in non-deterministic experiments. Illustration of countable and uncountable sample spaces connected to different random experiments. [**1**] Event and Event space: need of the ideas of field & sigma field in probability theory. Idea of minimal sigma-field. Construction of minimal sigma field. Borel field &Borel sets in R [**3]** Definitions of sure event ,impossible event , mutually exclusive and exhaustive events along with examples. Monotone sequence of events: contracting and expanding sequence. Limit of monotone sequence of events. Limit superior and limit inferior of an arbitrary sequence of events.[**2**] Introduction to the idea of probability: different types of definition: Classical Laplace definition: some simple combinatorial problems based on it [**3**]-Shortcomings of this classical approach and Axiomatic approach as an alternative. [Kolmogorov's probability axioms].[**1**] Probability defined as a set function on countable and uncountable sample spaces. Properties of probability function, Addition Theorem on Probability (proof based on Mathematical Induction included)[**3**].Concept of Probability space. Boole's and Bonferroni's inequalities. Axiom of Continuity [Proofs included] [**3**] Conditional Probability- definition ,examples, verification that conditional probability is a probability in its own right.[**1**] Multiplication rule of probability, Theorem of total probability, Bayes' theorem and related problems. [**3**] Independence of two events-extension to a finite/ countably infinite collection of events, Pairwise and mutual independence, problems.[**2**] Introduction to one dimensional random variables: Random variable as Borel measurable function. Induced probability space [its justification as probability space according to Kolmogorov's axioms] [**2**]. Distribution function and derivation of its properties from those of probability measure **[3**] Classification of random variables: discrete , continuous and absolutely continuous types based

	on the nature of the distribution function . Probability mass function (pmf) and probability density function (pdf)[**1**] . Transformation of one dimensional random variable (discrete and continuous) –theory and problems.[**2]** Examples of Discrete and Continuous random variables: Binomial distribution –Poisson approximation. Poission distribution ,Uniform distribution, Normal distribution and its symmetry features.[**3**] Raw and central moments for univariate distributions [**1**]. Mean, median, variance, skewness and kurtosis and their interpretations [**2**]. Two dimensional random variable: definition and examples, probability space for the two dimensional random variables: Joint distribution function. Marginal distribution function [**3**] Joint probability mass function and joint probability density function definition and simple problems related to them [**2**]. Bivariate Normal and Uniform distributions.[**3**] Transformation of two-dimensional continuous random variables and related problems[**3**] Statistical dependence and independence of two random variables-discussions at the pmf/pdf level [**1**] Moments for jointly distributed random variables. Covariance and correlation coefficient: properties &Interpretations.[**2**] Determination of linear regression equation using principles of least squares [**2**]
Learning Outcomes	On successful completion of the course a student will be able to do the following: • Learning the axiomatic approach to probability theory given by Kolmogorov and understanding the basic results of probability and its applications to various problems. • Understanding random variables and their distribution functions. • Learning different discrete and continuous distributions in univariate as well as bivariate cases and applications to different problems. • Understanding moments, moment generating functions that characterize distributions. • Learning the idea of linear regression using principles of least squares and its interpretations.
Reading/Reference Lists	1. Basic Probability Theory: Robert B-Ash 2. Introduction to Probability Theory: Sheldon Ross 3. Modern Probability Theory: B.R.Bhatt 4. Introduction to Probability Theory: Hoel, Port & Stone 5. Mathematical Probability: Banerjee, De & Sen
Evaluation	End Sem;70 CIA:30 (20 (MidSem)+5(Assignment)+5(Attendance)
Paper Structure for	7 questions each carrying 10 marks out of 13/14 questions.

Theory Semester Exam	