.**SCHEME OF COURSE WORK**

Course Title	:Random Variables and Numerical Methods		
Course Code	:13BM1107	L T P C	4 1 0 3
Program:	:B.Tech		
Specialization:	: Electronics and Communication Engineering		
Semester	:IV		
Prerequisites	:Fundamentals of Set theory, Basic concepts of Probability, Calculus		
Courses to which it is a prerequisite	: Probabilistic models, Numerical techniques to solve real world applications		

Course Outcomes (Cos):

1	Explain various concepts of discrete and continuous random variables
2	Determine joint distribution function and density function of multiple random variables
3	Examine the properties of Joint Gaussian Random Variables and classify random processes.
4	Determine numerical solution of algebraic and transcendental equations and discuss different difference operators.
5	Use interpolation techniques for data analysis, develop and apply numerical integration techniques and numerically solve initial value problems.

Course Outcomes versus Program Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	S											
CO3	S											
CO4	S											
CO5	S											

S - Strongly correlated, M - Moderately correlated, Blank - No correlation

Teaching-Learning and Evaluation

Week	TOPIC / CONTENTS	Course Outcomes	Sample questions	TEACHING-LEARNING STRATEGY	Assessment Method & Schedule
1	The Random Variable Concept, Discrete, Continuous, Mixed random variable, distribution function, Density function and properties.	CO-1	Determine whether the following function is a distribution function. $$G_x(x) = \begin{cases} e^{\frac{-x}{2}}, & x \geq 0 \\ 0, & x < 0 \end{cases}$$	Lecture / Problem solving	Assignment (Week 2 - 4) / Quiz-I (Week -8)/ Mid-Test 1 (Week 9)
2	The Gaussian Random variable, Conditional distribution and density Function. Expected value, Conditional expected value, Moments, Moments about the origin	CO-1	Find the probability of the event $\{X \leq 5.5\}$ for a Gaussian random variable X having $a_X = 3$ and $\sigma_X = 2$	Lecture / Problem solving	Assignment (Week 2 - 4)/ Quiz -I (Week -8)/ Mid-Test 1 (Week 9)
3	Central moments, Variance and Skew, Chebychev's inequality, Markov's inequality. Monotonic and Non monotonic transformations of a continuous random variable, Transformations of a discrete random variable.	CO-1	The natural numbers are the possible values of a random variable X, These numbers occur with probabilities $P(X_n) = (1/2)^n$. Find expected value of X.	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Assignment (Week 2 - 4)/ Quiz -I (Week -8)
4	Vector random variables, Joint distribution and its properties, Joint density and its properties	CO-2	Write the properties of Joint density function.	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Quiz -I (Week -8)
5	Conditional distribution and density statistical independence distribution and density of a sum of random variables, Central limit theorem (without proof).	CO-2	Show that the mean value of a weighted sum of random variables equals to the weighted sum of mean values.	Lecture / Problem solving	Mid-Test 1 (Week 9) / Quiz -I (Week -8)
6	Expected value of a function of random variables, Joint moments about the origin, Joint central moments	CO-2	Random variable X and Y have the joined density $$f_{X,Y}(x,y) = \begin{cases} \dfrac{1}{24}, & 0 < x < \\ & 0 < y \\ 0, & \text{else where} \end{cases}$$ What is the expected value of the function $g(X,Y) = (XY)^2$	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Quiz -I (Week -8)
7	Jointly Gaussian random variables, Transformations of multiple random variables- One function,	CO-3	Find marginal density functions of X and Y if Random variables *X and Y* are jointly Gaussian and normalized	Lecture / Problem solving	Mid-Test 1 (Week 9) / Quiz -I (Week -8)
8	Transformations of multiple random variables- multiple functions	CO-3	Let the transformations be linear and given by $$Y_1 = T_1(X_1, \quad X_2) = aX_1 + bX_2$$ $$Y_2 = T_2(X_1, \quad X_2) = cX_1 + dX_2$$ where a, b, c, d are constants. then find $f_{Y_1,Y_2}(y_1, y_2)$	Lecture / Problem solving	Mid-Test 1 (Week 9) / Quiz -I (Week -8)
9	**Mid-Test 1**	-----		-----	-----------
10	Linear transformation of Gaussian random variables and related Problems	CO-3	Show that Linear Transformation of Gaussian is Gaussian	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)/ Assignment (12-14)
11	The Random process concept classification of processes Deterministic	CO-3	Sample functions in a discrete random process are constants. That	Lecture / Problem	Assignment (Mid-Test 2

	and on deterministic processes.		is X(t)=C where C is a discrete random variable with possible values c1=1, c2=2, and c3=3 occurring with probabilities 0.6, 0.3 and 0.1 respectively. Is X(t) deterministic?	solving	(Week 18) / Quiz -II (Week -17)/ Assignment (12-14)
12	Introduction to Numerical Methods, Solution of algebraic and transcendental equations-bisection method, Method of false position Newton's method.	CO-4	Evaluate $\dfrac{3}{2}$ by Newton's iteration method (correct to four decimal places).	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)/ Assignment (12-14)
13	Finite differences-Forward differences, Backward differences, Central differences, Differences of a polynomial, Other Difference operators – Shift operator, Average operator, Relations between the operators,	CO-4	Express $\Delta^3 y_0$ in terms of y at different points	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
14	Newton's interpolation formulae - Newton's forward interpolation formula Newton's backward interpolation formula.	CO-4	Estimate the value of $f(0)$ and $f(6)$ for the following data. X 1 2 3 4 5 Y 0 5 22 57 116	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
15	Lagrange interpolation, Divided differences, Newton's divided difference formula, Inverse interpolation	CO-5	Estimate the value of x when $y = 10$ by inverse interpolation for the following data X 1 2 3 Y 5 9 15	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
16	Numerical Integration-Trapezoidal, Simpson's one-third and Simpson's three-eighth rules.	CO-5	Evaluate $\displaystyle\int_0^1 \dfrac{dx}{1+x^2}$ by Trapezoidal rule.	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
17	Euler's Method, Modified Euler's Method, Runge-Kutta method of order 4.	CO-5	Find $y(0.1)$, if $\dfrac{dy}{dx} = 3x + y,\ y(0) = 1$ by Runge Kutta method.	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
18	Mid-Test 2				
19/20	END EXAM				