SCHEME OF COURSE WORK

Course Details:

Course Title	**Random Variables and Numerical Methods**		
Course Code	**13BM1107**	**L T P C**	**4 1 0 3**
Program:	**B.Tech.**		
Specialization:	**Electrical and Electronics Engineering**		
Semester	**IV Semester**		
Prerequisites	• Fundamentals of Set theory and calculus. • Basic concepts of Probability and Discrete Random Variables. • Basic concepts of calculus		
Courses to which it is a prerequisite	**Signal and Systems**		

Course Outcomes (COs): At the end of the Course, Student will be able to

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.

Program Outcomes (POs):

The student of Electrical and Electronics Engineering at the end of the program will be able to:

1	Apply the knowledge of basic sciences and electrical and electronics engineering fundamentals to solve the problems of power systems and drives.
2	Analyze power systems that efficiently generate, transmit and distribute electrical power in the context of present Information and Communications Technology
3	Design and develop electrical machines and associated controls with due considerations to societal and environmental issues
4	Design and conduct experiments, analyze and interpret experimental data for performance analysis
5	Apply appropriate simulation tools for modeling and evaluation of electrical systems
6	Apply the electrical engineering knowledge to assess the health and safety issues and their consequences
7	Demonstrate electrical engineering principles for creating solutions for sustainable development
8	Develop a techno ethical personality that help to serve the people in general and Electrical and Electronics Engineering in particular
9	Develop leadership skills and work effectively in a team to achieve project objectives
10	Communicate effectively in both verbal and written form
11	Understand the principles of management and finance to manage project in multi disciplinary environments
12	Pursue life-long learning as a means of enhancing the knowledge and skills

Course Outcome versus **Program Outcomes:**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO-1	S	M		M	M							M
CO-2	S	M		M	M							M
CO-3	S	M		M	M							M
CO-4	S	M			M							M
CO-5	S	M		M	M							M

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

Assessment Methods:	Assignment / Quiz / Seminar / Mid-Test / End Exam

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, properties	**CO-1**	If $f\ x\ = \frac{1}{18}\ 2x + 3\ ,\ for\ 2 \leq x \leq 4$ is density function, find $P(2 \leq X \leq 3)$	Lecture / Problem solving	Assignment (Week 3 - 4)/ Quiz -I (Week -8)/ Mid-Test 1 (Week 9)
2	The Gaussian Random Variable, problems Conditional Distribution and Density Function, problems	**CO-1**	In a Normal distribution, 7% of the items are under 35 and 89% are under 63. Determine the mean and variance of the distribution.	Lecture / Problem solving	Assignment (Week 3 - 4)/ Quiz -I (Week -8)/ Mid-Test 1 (Week 9)
3	Conditional Distribution and Density Function, problems, Expectation, Expected value, Conditional Expected value, Moments, Moments about the origin, Central moments, Variance and Skew, Chebychev's Inequality, Markov's Inequality	**CO-1**	Find the mean and variance of uniform distribution	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Assignment (Week 3 - 4)/ Quiz -I (Week -8)
4	Monotonic and Non monotonic Transformations of a continuous random variable, Transformations of a Discrete random variable.	**CO-1**	Show that linear transformation of a Gaussian random variable is Gaussian	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Quiz -I (Week -8)
5	Vector Random Variables, Joint Distribution and its Properties Joint Density and its Properties	**CO-2**	If the Joint sample space S_j has only three possible elements (1, 1), (2, 1) and (3, 3) and their probabilities be 0.2, 0.3 and 0.5, find $F_{X,Y}(x, y)$ and the marginal distributions $F_X(x)$ and $F_Y(y)$.	Lecture / Problem solving	Mid-Test 1 (Week 9) / Quiz -I (Week -8)
6	Conditional Distribution and Density Statistical Independence	**CO-2**	Show that two un correlated Gaussian random variables are independent	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Quiz -I (Week -8)
7	Distribution and Density of a sum of Random Variables, Central Limit Theorem (without proof). Expected Value of a Function of Random Variables	**CO-2**	The random variables *X and Y* have the joint density What is the expected value the function $g(X,Y) = (XY)^2$	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Quiz -I (Week -8)
8	Joint moments about the origin, Joint central moments	**CO-2**	Find the Covariance C_{UV} of the random variables U, V where $U = X + Y, V = X - Y$ if X, Y are any two random variables with $\pm_X{}^2 = 2, \pm_Y{}^2 = 1$	Lecture / Problem solving	Mid-Test 1 (Week 9)/ Quiz -I (Week -8)
9	**Mid-Test 1**				
10	Jointly Gaussian Random Variables-two Random variables Jointly Gaussian Random Variables-N	**CO-3**	Write the properties of Joint Gaussian random variables.	Lecture / Problem	Mid-Test 2 (Week 18) / Assignment -II

	Random variables			solving	(Week -17)/ Assignment (113-14)
11	Transformations of Multiple Random Variables- One function, transformations of Multiple Random Variables- Multiple functions	**CO-3**	Two independent random variables X and Y have mean values E(X) =2, E(Y) =4 and their 2nd moments are $E(X^2)$ =8, E (Y^2) =25. Find (i) Mean value (ii) 2^{nd} moment (iii) Variance of the random variable W=3X-Y	Lecture / Problem solving	Assignment (Mid-Test 2 (Week 18) / Assignment -II (Week -17)/ Assignment (13-14)
12	The Random Process Concept- Classification of processes, Deterministic and Nondeterministic processes	**CO-3**	Discuss about classification of random Processes.	Lecture / Problem solving	Mid-Test 2 (Week 18) / Assignment -II (Week -17)/ Assignment (13-14)
13	Solution of algebraic and transcendental equations: bisection method, method of false position, Newton's method.	**CO-4**	Find the real root of the equation $cosx = xe^x$ using the regular falsi method corrected to four decimal places.	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
14	Finite differences: Forward differences, Backward differences, Central differences, Differences of a polynomial, Other Difference operators,	**CO-4**	Form a table of difference for the function $f\ x\ = x^3 + 5x - 7$ for x= -1, 0, 1, 2, 3, 4, 5. Continue the table to obtain f(6).	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
15	Relations between the operators, Newton's interpolation formulae- Newton's forward interpolation formula Newton's backward interpolation formula,	**CO-4**	Using Newton's interpolation formula find the value of the f(1.2) up to three decimals, given that f(1)=3.49, f(1.4)=4.82, f(1.8)=5.96, f(2.2)=6.5.	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
16	Interpolation with un equal intervals: Lagrange interpolation, Divided differences, Newton's divided difference formula Difference formula, Inverse interpolation. Numerical Integration – Newton-cote's quadrature formula	**CO-5**	Use the Lagrange's formula to find the form of f(x) for the given data x: 0, 2, 3, 6 f(x): 648, 704, 729, 792	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
17	Trapezoidal rule Simpson's $1/3^{rd}$ rule Simpson's $3/8^{th}$ rule, Weddle's rule. Numerical solutions of Ordinary differential equations: Euler's Method, Modified Euler's Method, Runge-Kutta method of order 4	**CO-5**	Apply the fourth order Runge-Kutta method to find an approximate value of y when x=1.2 in steps of 0.1, given that $\frac{dy}{dx} = x^2 + y^2$ and y (1) = 1.5.	Lecture / Problem solving	Mid-Test 2 (Week 18) / Quiz -II (Week -17)
18	**Mid-Test 2**				
19/20	**END EXAM**				