Register No : ________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025

Third Semester

Electronics and Communication Engineering

MA3355 / UMAT24305 - Random Processes and Linear Algebra

(Common to Fourth Semester Biomedical Engineering)

(Usage of Statistical table can be permitted)

Regulations - 2021

Duration : 3 Hrs *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	Questions	BLT	CO	Marks
1.	Write short notes on Probability density function.	L1	1	2
2.	What are the limitations of Poisson distribution?	L1	1	2
3.	Distinguish between Linear and non-linear regression.	L4	2	2
4.	The regression equation of 2 variables X and Y are $X = 0.7Y + 5.2, Y = 0.3X + 2.8$. Find the means of the 2 variables.	L1	2	2
5.	State any two properties of Poisson process.	L1	3	2
6.	What is meant by steady – state distribution of Markov chain?	L1	3	2
7.	Prove that the intersection of two subspaces of a vector space is a subspace.	L2	4	2
8.	Prove, any finite - dimensional vector space V contains a finite number of linearly independent vectors which span V.	L2	4	2
9.	Let T : V →W be a linear transformation Then $T(V) = \{T(v)/ v \in V\}$ is a subspace of W.	L2	5	2
10.	Let S = $\{v_1, v_2 \dots v_n\}$ be an orthogonal set of non-zero vectors in an inner product space V. Then S is linearly independent.	L2	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)*

Q.No			Questions	BLT	CO	Marks
11.	a	i	A manufacturing firm produces tennis ball in 3 plants with a daily production volume of 600,900 and 2000 balls respectively. Account to the past experience it is known that 0.006,0.007 and 0.010 respectively are defective. If a ball is selected from a day's total production and found to be defective, what is the probability that it comes from the first plant?	L2	1	10
		ii	Find the moment generating function of the RV X whose probability function P(X = x) = $\frac{1}{2^x}$, x = 1, 2, … Hence find its mean.	L2	1	6
			Or			
	b	i	If X is a Poisson variate such that $P(X = 2) = 9P(X = 4) + 90P(X = 6)$, find the variance.	L2	1	8
		ii	If X is a random variable uniformly distributed in (0,1), find the pdf of Y = $\sin x$. Also find the mean and variance of Y.	L2	1	8

12.	a	i	Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X,Y).	L2	2	6
		ii	10 Students got the following % of marks in statistics at degree examination and a competitive examination.	L2	2	10

Students:	1	2	3	4	5	6	7	8	9	10
Marks in DE	78	40	94	22	76	84	90	62	65	39
Marks in CE	84	51	91	60	68	62	86	58	53	47

Find the coefficient of correlation.

Or

	b	i	Two random variables X and Y have the joint density function $f(x,y)=\begin{cases}2-x-y, 0<x<1, 0<y<1\\ 0, \; otherwise\end{cases}$ Show that $\text{Cov}(X,Y)=\frac{-1}{144}$.	L2	2	8
		ii	The regression equation of X and Y is $3Y-5X+108=0$. If the mean value of Y is 44 and the variance of X were $9/16^{th}$ of the variance of Y, find the mean value of X and the correlation coefficient.	L2	2	8
13.	a	i	Show that the Random process $X(t) = A\,Cos\,(\omega_0 t + \theta)$ is not satisfactory. If A and ω_0 are constants and θ is uniformly distributed random variable in (0, π).	L3	3	8
		ii	Prove that the matrix: $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1/2 & 1/2 & 0 \end{bmatrix}$ is the tpm of an irreducible Markov chain.	L2	3	8

Or

	b	i	Derive mean, variance and moment generating function of Poisson Process.	L3	3	8
		ii	The process {X (t)} whose probability distribution under certain conditions is given by, $P\{X(t)=n\}=\frac{(at)^{n-1}}{(1+at)^{n+1}}, n=1,2,.....$ $= \frac{at}{1+at}, n=0$ Show that it is not stationary (or evolutionary).	L2	3	8
14.	a	i	If A and B are subspaces of V prove that A + B = {$v\in V$ = $a+b$, $a \in A$, $b \in b$} is a subspace of V. Further show that A+B is the smallest subspace containing A and B. (i.e) If W is any subspace of V containing A and B then W contains A+B.	L2	4	8
		ii	Let V be a finite dimensional vector space over a field over F. Let A be a subspace of V. Then there exists a subspace B of V such that V = A $\oplus$ B.	L2	4	8

Or

	b	i	Let V be a vector space over F and W a subspace of V. Let V/W = { W+ $v / v \in V$}. Then V/W is a vector space over F under the following operations. (i) $(W+v_1)+(W+v_2) = W+v_1+v_2$ (ii) $\alpha(W+v_1) = W+\alpha v_1$	L2	4	8
		ii	Let V be a finite dimensional vector spaces over a field F. Let W be a subspace of V. Then (i) $\dim V \leq \dim V$. (ii) $\dim \frac{V}{W} = \dim V - \dim W$.	L2	4	8
15.	a	i	Let T be a linear map from a vector space $\mathrm{V(F)}$ into a vector space U(F). Then range space R(T) is a subspace of U(F).	L3	5	8
		ii	Prove that, The norm defined in an inner product space V has the following properties. (i) $\|x\| \geq 0 \; and \; \|x\| = 0 \; iff x = 0$ (ii) $\|\alpha x\| = \|\alpha\|\|x\|$ (iii) $\|\langle x, y\rangle\| = \|x\|\|y\|$ (Schwartz's inequality) (iv) $\|x+y\| \leq \|x\|+\|y\|$ (Triangle inequality)	L1	5	8
			Or			
	b	i	Apply Gram-Schmidt process to construct an orthogonal basis for $V_3(R)$with the standard inner product for the basis $\{v_1, v_2, v_3\}$ where $v_1 = \{1,0,1\}, v_2 = \{1,3,1\}, v_3 = \{3,2,1\}$.	L3	5	8
		ii	Show that $V = W \oplus W^{-1}$, W being a subspace of a finite dimensional inner product space V.	L1	5	8