Register No : ____________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL/MAY 2026

Fourth Semester

Biomedical Engineering

UMAT24305 / MA3355 – Random Processes and Linear Algebra

(Common to Third Semester Electronics and Communication Engineering)

Regulations – 2024 & 2021

Duration : 3 Hrs *Maximum : 100 Marks*

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

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	A box contains 4 bad and 6 good tubes. Two are drawn out from the box at a time. One of them is tested and found to be good. Find the probability that the other one is also good.	L2	1	2
2.	Define Poisson distribution.	L1	1	2
3.	Show that the function defined as follows is a density function: $f(x,y) = \begin{cases} \frac{2}{5}(2x+3y), 0 \le x \le 1, 0 \le y \le 1 \end{cases}$	L1	2	2
4.	The regression equations of X on Y and Y on X are respectively $5x - y = 22 \text{ and } 64x - 45y = 24$. Find the means of X and Y.	L2	2	2
5.	Define Stationary process.	L1	3	2
6.	The one-step transition probability matrix of a Markov chain with states (0, 1) is given by $P = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$. Is it irreducible Markov chain?	L2	3	2
7.	Write the possible subspace of R^2.	L1	4	2
8.	Demonstrate whether the vectors $v_1 = (1,2,1), v_2 = (2,1,0)$ and $v_3 = (1,-1,2)$ form a linearly independent or linearly dependent in $V_3(R)$.	L2	4	2
9.	Let $T: R^2 \to R^2$ is a function, $T(a_1, a_2) = (a_1, {a_2}^2)$.Prove that T is not linear.	L2	5	2
10.	Define Adjoint matrix.	L1	5	2

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

Q.No			*Questions*	*BLT*	*CO*	*Marks*
11.	a	i	Four boxes A,B,C,D contains fuses. The boxes contain 5000, 3000,2000 and 1000 fuses respectively. The percentages of fuses in boxes which are defective are 3%,2%,1% and 0.5% respectively. One fuse is selected at random arbitrarily form one of the boxes. It is found to be defective fuse. Calculate the probability that it has come from box D.	L3	1	8
		ii	A random variable 'X' has the following probability function:	L3	1	8

X	0	1	2	3	4	5	6	7	8
p(x)	a	3a	5a	7a	9a	11a	13a	15a	17a

(i) Determine the value of 'a'

(ii) Find $P(X < 3), P(X \ge 3), P(0 < X < 3)$

Or

	b	i	Determine the moment generating function of the binomial random variable with parameters n and p and hence find its mean and variance.	L3	1	8
		ii	Drive the memoryless property of exponential distribution.	L3	1	8
12.	a		Let the joint p.d.f . of $R.V.(X,Y)$ be given as	L3	2	16

$$f(x,y) = \begin{cases} Cxy^2, & 0 \le x \le y \le 1 \\ 0, & otherwise \end{cases}$$. Determine the

i) Value of C

ii) Marginal p.d.f. of X & Y

Conditional p.d.f. $f\left({}^{x}/_{y}\right)$ and $f\left({}^{y}/_{x}\right)$

Or

b i Calculate the coefficient of correlation for the following data: L3 2 8

X	9	8	7	6	5	4	3	2	1
Y	15	16	14	13	11	12	10	8	9

ii If X and Y are independent RVS with p.d.f $e^{-x}, x \ge 0$ and $e^{-y}, y \ge 0$ respectively. Solve the density functions of $U = \frac{X}{X+Y}$ and $V = X + Y$. Are U and V independent? L3 2 8

13. a Consider the Markov chain$\{X_n; n = 1,2,3, \ldots\}$ having state space L3 3 16

$S = \{1,2,3\}$ and one step TPM $P = \begin{bmatrix} 0 & 1 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} \\ 1 & 0 & 0 \end{bmatrix}$ initial probability

distribution $P(X_0 = i) = \frac{1}{3} i = 1,2,3$. Solve the following

i) $P(X_3 = 2, X_2 = 1, X_1 = 2/X_0 = 1)$

ii) $P(X_3 = 2, X_2 = 1/X_1 = 2, X_0 = 1)$

iii) $P(X_2 = 2/X_0 = 2)$

iv) Invariant probabilities of the Markov chain

Or

	b	i	Show that the difference of two independent Poisson processes is not the Poisson process.	L3	3	8
		ii	State and prove Chapman – Kolmogorov equations.	L3	3	8
14.	a		Find the bases and dimension for the column space and row space for the matrix	L3	4	16

$$A = \begin{bmatrix} 1 & 2 & -5 & 11 & -3 \\ 2 & 4 & -5 & 15 & 2 \\ 1 & 2 & 0 & 4 & 5 \\ 3 & 6 & -5 & 19 & -2 \end{bmatrix}.$$

Or

	b		Interpret that every linearly independent subset of a finitely generated vector space $V(F)$ is either a basis of V or can be extended to form a basis of V.	L2	4	16

15.	a	Consider the basis $s = \{v_1, v_2, v_3\}$ for R^3 , where $v_1 = (1,1,1), v_2 = (1,1,0)$ and $v_3 = (1,0,0)$. Let $T: R^3 \to R^2$ be the linear transformation such that $T(v_1) = (1,0)$, $T(v_2) = (2,-1)$ and $T(v_3) = (4,3)$. Examine the formula for $T(x_1, x_2, x_3)$ then use this formula to compute $T(2,-3,5)$.	L3	5	16
		Or			
	b	Let R^3 have the Euclidean inner product. Use the Gram -Schmidth processs to transform the basis $\{u_1, u_2, u_3\}$ into an orthonormal basis, where $u_1 = (1,1,1), u_2 = (0,1,1)$ and $u_3 = (0,0,1)$.	L3	5	16