

Reg. No. :

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Question Paper Code: R4M24

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Fourth Semester

Biomedical Engineering

R21UMA424- PROBABILITY AND INFERENCE STATISTICS

(Common to Biotechnology)

(Regulations R2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. If the probability mass function of a random variable X is given by $P(X = r) = Kr^2$, $r = 1, 2, 3, 4$. Find k. CO1-App
2. Define: Exponential Distribution and its mean, variance. CO1- App
3. Define: Rank Correlation CO2- App
4. Define: correlation coefficient between X and Y. CO2- App
5. State any two properties of an autocorrelation function. CO6- U
6. Show that autocorrelation function is an even function. CO3- App
7. What is unit impulse response of a system? CO6- U
8. Define white noise. CO6- U
9. Write the application of 't' test. CO6- U
10. Write the formula for the chi- square test of goodness of fit of a random sample to a hypothetical distribution CO6- U

PART – B (5 x 16= 80 Marks)

11. (a) (i) A R.V. X has the following distribution CO1- App (8)

X	0	1	2	3	4	5	6
P(X)	a	2a	3a	5a	6a	6a	8a

(a) Find 'a' (b) Find $P(X \geq 2)$, $P(2 \leq X \leq 5)$ and (c) Find $E(X)$.

- (ii) A manufacturer produces light-bulbs that are packed into boxes of 100. If quality control studies indicate that 0.5% of the light-bulbs produced are defective, what percentage of the boxes will contain: (a) no defective? (b) 2 or more defectives? CO1- App (8)

Or

- (b) (i) If the density function of a continuous r.v X is given by CO1- App (8)

$$f(x) = \begin{cases} ax & 0 \leq x \leq 1 \\ a & 1 \leq x \leq 2 \\ 3a - ax & 2 \leq x \leq 3 \\ 0 & \text{otherwise} \end{cases} . \text{ (a) Find the value of "a"}$$

(b) Find the c.d.f. of X .

- (ii) Explain M.G.F of Exponential distribution and hence find mean and variance. CO1- App (8)

12. (a) (i) The joint probability mass function of (X,Y) is given by $P(x,y) = k(2x + 3y)$, $x = 0, 1, 2$; $y = 1, 2, 3$. Find all marginal distribution function and conditional distribution. CO2 - App (8)

- (ii) Joint pdf of x and y is $f(x,y) = \begin{cases} 2 - x - y, & 0 \leq x, y \leq 1 \\ 0 & \text{elsewhere} \end{cases}$. Find marginal density function of x and y , mean of x , mean of y . CO2 - App (8)

Or

- (b) Find coefficient of correlation between capital employed and profit obtained from the following data. CO 2 - App (16)

Capital Employed (Rs. In Crore)	10	20	30	40	50	60	70	80	90	100
Profit (Rs. In Crore)	2	4	8	5	10	15	14	20	22	50

And also find Regression Equations x on y & y on x .

13. (a) (i) Find power spectral densities of the following auto correlation function $R(\tau) = e^{\frac{-\alpha^2 \tau^2}{2}}$ CO3- App (8)

- (ii) Examine whether the random process $X(t) = A \cos(\alpha t + \theta)$ is a wide sense stationary if A and α are constants and θ is uniformly distributed random variable in $(0, 2\pi)$. CO3- App (8)

Or

- (b) Consider the two random process $X(t) = 5\cos(\omega t + \theta)$ and $Y(t) = 2\cos(\omega t + \theta - \frac{\pi}{2})$. Where θ is uniformly distributed random variable in $(0, 2\pi)$ then Prove that $|R_{XY}(\tau)| \leq \sqrt{R_{XX}(0) \cdot R_{YY}(0)}$. CO3- App (16)

14. (a) If $X(t)$ is the input Voltage to a circuit and $Y(t)$ is the Output Voltage, $X(t)$ is a stationary random process with $E(x) = 0$ and $R_{XX}(\tau) = e^{-4|\tau|}$. Find $E(Y)$, $S_{XX}(\omega)$ & $S_{YY}(\omega)$ if the system transfer function is given by $|H(\omega)|^2 = \frac{1}{3^2 + \omega^2}$. CO4- App (16)

Or

- (b) If the input to a time invariant stable linear system is a wide sense stationary process. Prove that the output will also be a wide sense stationary process CO4- App (16)

15. (a) (i) 4 coins were tossed 160 times and the following results were obtained: CO5-App (8)

No. of heads:	0	1	2	3	4
Observed frequencies:	17	25	27	33	6

Under the assumption that the coins are unbiased, find the expected frequencies of getting 0, 1, 2, 3, 4 heads and test the goodness of fit.

- (ii) Two sample polls of votes for two candidates A and B for a public office are taken one from among residents of rural areas. The results are given below. Examine whether the nature of the area is related to voting preference in this election. CO5-App (8)

Area/Votes for	A	B	Total
Rural	620	380	1000
Urban	550	450	1000
Total	1170	830	2000

Or

- (b) (i) Two independent samples of sizes 9 and 7 from a normal population had the following values of the variables. CO5-App (8)

Sample I	18	13	12	15	12	14	16	14	15
Sample II	16	19	13	16	18	13	15	-	-

Investigate the estimates of the population variance differ significantly at 5% level?

- (ii) Two independent samples are chosen from two schools A and B, a common test is given in a subject. The scores of the students as follows: CO5–App (8)

Section A	76	68	70	43	94	68	33	-
Section B	40	48	92	85	70	76	68	22

Can we conclude that students of school A performed better than students of section B?