A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 94024

B.E./B.Tech. DEGREE EXAMINATION, MAY 2022

Fourth Semester

Bio Medical Engineering

19UMA424 - Probability and Inferential Statistics

(Common to Bio Technology)

(Regulations 2019)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Probability of an impossible event is CO6-R
   (a) 1 (b)10 (c)0 (d) ∞
2. Probability of sure event is CO6-R
   (a) 0 (b) 1 (c) 2 (d)10
3. If X and Y are independent random variables then CO6-U
   (a) f(x,y) = f(x) . f(y) (b)f(x,y) = f(x) + f(y) (c)f(x,y) = 0 (d) None of the above
4. The marginal density function of X is CO6-R
   (a) f(y) (b) f(x,y) (c) f(x) (d) f (x/y)
5. If the Random Process {X(t)} with mean has Auto correlation function $R(\tau) = 16 + 9e^{-|\tau|}$ Then the Variance of the process is CO3- App
   (a) 16 (b)25 (c) 6 (d) 9
6. Autocorrelation function is maximum at τ = CO6-R
   (a) 0 (b)1 (c) -1 (d) ∞
7. The system is said to be stable if CO6-R
   (a) $\int_{-\infty}^{\infty} h(t)\ dt < \infty$ (b) $\int_{-\infty}^{\infty} h(t)\ dt > \infty$ (c) $\int_{-\infty}^{\infty} h(t)\ dt > 0$ (d) None of the above
8. If $S_{XX}(\omega)$ *and* $S_{YY}(\omega)$ *are the* input and output power spectral density and H(ω) is the transfer function then CO6-R
   (a) $S_{XX}(\tau) = |H(\omega)|^2 S_{YY}(\omega)$ (b) $S_{XY}(\tau) = |H(\omega)|^2 S_{XX}(\omega)$
   (c) $S_{YY}(\omega) = |H(\omega)|^2 S_{XX}(\omega)$ (d) None of the above

9. Large sample size is _____ CO6-U

(a) 30 (b) >30 (c)<30 (d) None of the above

10. The degrees of freedom for Binomial distribution is _____ CO6-U

(a) (n -1)(n-2) (b) n -2 (c) (n -1)(n-3) (d) n -1

PART – B (5 x 2= 10Marks)

11. A Continuous random variable with density function is given by CO1-App

$f(x) = 6x(1-x), 0 \le x \le 1$ Check the above is PDF or not.

12. The joint probability mass function of (X, Y) is CO2-App

$P(x, y) = kxy \quad x = 1,2,3; \quad y = 1,2,3$ Determine the value of constant k.

13. Prove that $|R_{xx}(\tau)| \le R_{xx}(0)$ CO3-U

14. Calculate the value of the system transfer function,if the input of the system with impulse response $h(t) = e^{-3t}U(t)$. CO4-U

15. Give two types of errors in testing a statistical hypothesis CO2-U

PART – C (5 x 16= 80Marks)

16. (a) A Random Variable X has the following probability distribution CO1-App (16)

X=x	0	1	2	3	4	5	6	7
P(X=x)	0	a	2a	2a	3a	a^2	$2a^2$	$7a^2+a$

Find

(i) 'a'

(ii) $P(X < 6), P(X \ge 6)$ & $P(1.5 < X < 6.5 / X > 5)$

(iii) If $P(X \le a) > \frac{1}{2}$, Find the minimum value of 'a'

(iv) Distribution function of x

Or

(b) (i) If $f(x) = \begin{cases} \frac{k}{1+x^2}, -\infty < x < \infty \\ o \quad , elsewhere \end{cases}$ is the Probability Density Function CO1- App (8)

of a Random variable X , (i) Find K (ii) distribution function of F(x)

(ii) State and Prove the memory less property for an Exponential Property. CO1- App (8)

17. (a) If the joint probability density function of X and Y is given by CO2-App (8)

$f(x, y) = kxye^{-(x^2+y^2)}, \ x > 0, y > 0$ Find the value of k and Prove also that X and Y are independent

If the joint probability density function of X&Y is given by $f(x,y) = e^{-(x+y)}$, $x > 0, y > 0$ Are X & Y independent. CO2-App (8)

Or

(b) (i) If X and Y are two random variables having joint probability mass function $f(x,y) = \frac{(2x+y)}{27}$, x= 0, 1, 2 and y = 0, 1, 2 find the marginal distribution of X and Y CO2 -App (8)

(ii) Obtain the Correlation coefficient for the following heights (in inches) of fathers X and their sons Y. CO2 -App (8)

X	65	66	67	67	68	60	70	72
Y	67	68	65	68	72	72	69	71

18. (a) (i) If the auto correlation function of the random binary transmission is given by $R_{XX}(\tau) = \begin{cases} 1 - \frac{|\tau|}{T} & ; |\tau| \le T \\ 0 & ; |\tau| \ge T \end{cases}$ Find the Power spectral density function CO3-U (8)

(ii) A stationary process has an autocorrelation function given by $R(\tau) = 25 + \frac{4}{1+6\tau^2}$ Find the Mean and Variance CO3-App (8)

Or

(b) (i) If the Power spectral density of a WSS processes is given by CO3-App (8)

$$S(\omega) = \begin{cases} \frac{b}{a}(a - |\omega|) & ; \quad |\omega| \le a \\ 0 & ; \quad |\omega| > a \end{cases}$$

Find the auto correlation function of the Process.

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

19. (a) A random process X (t) having the autocorrelation function $R_{xx}(\tau) = P e^{-\alpha|\tau|}$ Where b is a constant is applied to the input of the system with impulse responseh (t) = $e^{-bt}U(t)$ where b is a constant.Find the autocorrelation of the output Y (t). CO4-App (16)

Or

(b) If X (t) is a WSS process and if CO4-App (16)

$$Y(t) = \int_{-\infty}^{\infty} h(u)X(t-u)du \text{ then}$$

$$\text{(i).} R_{XY}(\tau) = R_{XX}(\tau) * h(\tau) \qquad \text{(ii).} R_{YY}(\tau) = R_{XY}(\tau) * h(-\tau)$$

$$\text{(iii).} S_{XY}(\omega) = S_{XX}(\omega) * H(\omega) \qquad \text{(iv).} S_{YY}(\omega) = S_{XX}(\omega) * |H(\omega)|^2$$

20. (a) (i) Two horses A and B were tested according to time (in seconds) to run on a particular track with the following results: CO5-Ana (8)

Horse A	28	30	32	33	33	29	34
Horse B	29	30	30	24	27	29	

Test whether horse A is running faster than B at 5% level.

(ii) The following data are collected on two characters. CO5-Ana (8)

	Skilled	Non Skilled
Male	40	20
Female	10	30

Using chi-square test to find is there any relation between skilled and Non Skilled

Or

(b) (i) The theory predicts the population of beans in the four groups A, B, C and D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the four groups were 882, 313, 287 and 118. Does the experimental result support the theory? CO5- Ana (8)

(ii) Two random samples gave the following results: CO5- Ana (8)

Samples	Size	Sample Mean	Sum of the squares of deviation from the mean
1	10	15	90
2	12	14	108

Examine whether the samples come from the same normal population