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

Question Paper Code:U4M22

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

Fourth Semester

Electronics and Communication Engineering

21UMA422 - PROBABILITY STATISTICS AND MATHEMATICAL STRUCTURES

(Regulations 2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The limiting form of a Binomial distribution is CO6- U

   (a) Exponential (b) Poisson (c) Normal (d) None of the above

2. The r^{th} moment about origin is CO6- U

   (a) $\mu(X)$ (b) $\mu(X^2)$ (a) $\mu(X)$ (d) X

3. Large sample size is _____ CO6- U

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

4. The degrees of freedom for the sample size n= 25 in Chi-square test is _____. CO6- U

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

5. SSE for one way design is CO6- U

   (a) 0 (b) TSS-SSC (c) TSS-SSC-SSR (d) TSS-SSC-SSR-SSK

6. The degrees of freedom for the variation due to error term in one way classification is CO6- U

   (a) N-1 (b) N-2 (c) (N-C) (d) C-1

7. If the Random Process {X(t)} with mean has Auto correlation function $R(\tau) = 16 + 9e^{-|\tau|}$ Then the Variance of the process is CO4- App

   (a) 16 (b) 25 (c) 6 (d) 9

8. Given $R(\tau) = 25 + \frac{4}{1+6\tau^2}$ What is $E[X^2(t)]$? CO4- App

(a) 25 (b) 29 (c) 26 (d) 27

9. $P \rightarrow \neg Q$ is equivalent to CO6- U

(a) $\neg P \wedge Q$ (b) $P \wedge \neg Q$ (c) $\neg(P \wedge Q)$ (d) $P \vee \neg Q$

10. If P:Mark is rich, Q: Mark is happy then the symbolic form of the statement is Mark is poor but happy CO5- App

(a) $\neg(P \wedge Q)$ (b) $P \wedge \neg Q$ (c) $\neg P \wedge Q$ (d) $P \vee \neg Q$

PART – B (5 x 2= 10 Marks)

11. A discrete random variable X with probability distribution CO1-App

X	0	1	2	3	4	5
P(X)	a	3a	5a	7a	9a	11a

Using the probability mass function, Calculate the value of the constant ' a ' and mean value.

12. If $S_1^2 = 1.354$ and $S_2^2 = 5.588$ then compute the value of F- ratio CO2- Ana

13. Write down the format of ANOVA table for one way classification CO3- Ana

14. The power spectrum of a WSS process X (t) is given by $S_{xx}(\omega) = \frac{4}{4+\omega^2}$ Find the autocorrelation. CO4 -App

15. Construct the truth table for $(P \wedge \neg Q) \vee (P \wedge R) \vee (Q \wedge R)$ CO5- App

PART – C (5 x 16= 80Marks)

16. (a) (i) A Random Variable X has the following probability distribution CO1-App (8)

X=x	0	1	2	3	4	5	6	7
P(X=x)	0	K	2 K	2 K	3 K	K^2	$2K_2$	$7K^2 + K$

Using probability mass function Compute the following

(i) 'K' (ii) P(X > 6), (iii) distribution function.

(ii) Using the probability mass function of Poisson distribution , CO1-App (8)
Compute the moment generating function and hence find mean and variance

Or

(b) (i) State and Prove the memory less property for an Exponential distribution — CO1- App — (8)

(ii) In a large consignment of electric bulbs 10 % are defective. A random sample 20 bulbs are taken for inspection. Find the probability that (i) all are good bulbs (ii) exactly three defective bulbs — CO1 -App — (8)

17. (a) Two researchers A and B adopted different techniques while rating the student's level. Identify the Sampling distribution; Can you say that the techniques adopted by them are significant? — CO2- Ana — (16)

Researchers	Below Average	Average	Above Average	Genius	Total
A	40	33	25	2	100
B	86	60	44	10	200
Total	126	93	69	12	300

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? — CO2- Ana — (8)

(ii) On the basis of information noted below, find out whether the new treatment is comparatively superior to the conventional one. Identify the sampling distribution. — CO2- Ana — (8)

	Favorable	Non-Favorable	Total
conventional	40	70	110
New	60	30	90
Total	100	100	200

18. (a) Analyze the following of Latin square design experiment,. — CO3- Ana — (16)

A (12)	D (20)	C (16)	B (10)
D (18)	A (14)	B (11)	C (14)
B (12)	C (15)	D (19)	A (13)
C (16)	B (11)	A (15)	D (20)

The letters A,B,C,D denote the treatments and the figures in brackets denote the observations,

Or

(b) A company appoints 4 salesman A, B, C and D and observes their sales in 3 seasons: Summer, winter and Monsoon. The figures (in lakhs of Rs.) are given in the following table: CO3- Ana (16)

		A	B	C	B
Season	Summer	45	40	38	37
	Winter	43	41	45	38
	Monsoon	39	39	41	41

Carry out an analysis of Variance.

19. (a) (i) If the auto correlation function of the random binary transmission is given by $R_{XX}(\tau) = \begin{cases} 1 - \dfrac{|\tau|}{T} & ; |\tau| \le T \\ 0 & ; |\tau| \ge T \end{cases}$ Find the Power spectral density function. CO4- App (8)

(ii) Using the properties of auto correlation function, compute the Mean , Mean Square value and Variance of $\mathbf{R_{XX}(\tau) = 25 + \dfrac{4}{1 + 6\tau^2}}$ CO4-App (8)

Or

(b) (i) If the Power spectral density of a WSS processes is given by CO4- App (8)

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

Find the auto correlation function of the Process.

(ii) Compute the power spectral density for the auto correlation function $R_{XX}(\tau) = e^{-\alpha\tau^2}, \alpha > 0$ CO4- App (8)

20. (a) (i) Compute the PCNF and PDNF for $(\neg P \to R) \wedge (Q \leftrightarrow P)$ CO5- App (8)

(ii) Using rules of inference theory and CP Rule, derive $P \to (Q \to S), \neg R \vee P, Q \Rightarrow R \to S$ CO5- App (8)

Or

(b) (i) Construct the truth table of $\neg(P \vee (Q \wedge R)) \leftrightarrow ((P \vee Q) \wedge (P \to R))$ CO5- App (8)

(ii) Prove that following Premises are inconsistent: CO5- App (8)
If the contract is valid then John is liable for penalty.
If John is liable for penalty then he will go bankrupt.
If the bank will loan him money then he will not go bankrupt.
As a matter of fact, The contract is valid and the bank will loan him money.