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Reg. No. :

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B.E./B.Tech. DEGREE EXAMINATION, APRIL 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. If A and B are independent events then $P(A \cap B)$ =   CO6- U

    (b) P (A). P(B)   (c) P(A) +P(B)   (b) P (A). P(B)   (c) P(A) +P(B)

2. The rth 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   CO4- App
    $R(\tau) = 16 + 9e^{-|\tau|}$ Then the Variance of the process is

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

8. Given $R(\tau) = 25 + \dfrac{4}{1 + 6\tau^2}$ 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. $P \vee (P \rightarrow Q)$ is Equivalent to　　　　　　　　　　　　CO5- App

    (a) Q　　　　　　(b) P　　　　　　(a) Q　　　　　　(b) P

PART – B (5 x 2= 10 Marks)

11. Using Probability mass function, Compute the mean value for the following distribution.　　　CO1-App

X	-2	-1	0	1
P(X)	0.4	0.1	0.2	0.3

12. A sample of size 10 has mean 58, standard deviation18.4 and population mean 50, Compute the calculated value of 't' distribution　　　CO2- Ana

13. For a one way classification on 12 observations involving 3 treatments the sum of squares of treatment and sum of squares of total are 8 and 36 respectively, compute the value of the F – ratio.　　　CO3- Ana

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

15. Compute PCNF for $\neg(P \rightarrow Q)$　　　　　　　　　　　　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	$\dfrac{2K}{2}$	$7K^2 + K$

    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 , Compute the moment generating function and hence find mean and variance　　　CO1-App　　(8)

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   CO1 -App   (8)
random sample 20 bulbs are taken for inspection. Find the
probability that   (i) all are good bulbs (ii) exactly three defective
bulbs

17. (a) (i) From the following two sample values, Identify the sampling   CO2- Ana   (8)
distribution find, if the variances are significantly different.

Sample 1	5	6	8	1	12	4	3	9	6	10
Sample 1	2	3	6	8	10	1	2	8		

(ii) Two horses A and B were tested according to time (in seconds)   CO2- Ana   (8)
to run on a particular track with the following results:

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

Identify the sampling distribution, test whether horse A is running
faster than B at 5% level.

Or

(b) (i) The theory predicts the population of beans in the four groups A,   CO2- Ana   (8)
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?

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

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

18. (a) The following table shows the lives in hours of four brands of   CO3- Ana   (16)
electric lamps.

Brand	1610	1610	1650	1680	1700	1720	1800	--
Brand	1580	1640	1640	1700	1750	--	--	--
Brand	1460	1550	1600	1620	1640	1660	1740	1820
Brand	1510	1520	1530	1570	1600	1680	--	--

Perform an analysis of variance test the homogeneity of the mean
lives of the four brands of lamps.

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Or

(b) 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,

19. (a) (i) If the auto correlation function of the random binary   CO4- App   (8)

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.

(ii) Using the properties of auto correlation function, compute the   CO4-App   (8)

Mean , Mean Square value and Variance of $R_{XX}(\tau) = 25 + \dfrac{4}{1 + 6\tau^2}$

Or

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

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

Find the auto correlation function of the Process.

(ii) Compute the power spectral density for the auto correlation   CO4- App   (8)

function $R_{XX}(\tau) = e^{-\alpha\tau^2}, \alpha > 0$

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,   CO5- App   (8)
derive $P \to (Q \to S), \neg R \vee P, Q \Rightarrow R \to S$

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 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 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.

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