**A**   Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐☐

## Question Paper Code: R1M03

B.E./B.Tech. DEGREE EXAMINATION, DEC 2025

First Semester

Computer Science and Business Systems

R21UMA103- PROBABILITY AND INFERENTIAL STATISTICAL TECHNIQUES

(Regulations R2021)

Duration: Three  hours                                      Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1.  Three unbiased coins are tossed. What is the probability of getting at most two        CO6-U
    heads?

    (a) ¾                  (b) ¼                  (c) 3/8                  (d) 7/8

2.  The sample for tossing a coin is                                                        CO6-U

    (a) {H, T}             (b) {H}                (c) {T}                  (d)None of these

3.  Which of the following continuous distributions follow memoryless property:            CO6-U

    (a) Geometric          (b) Exponential        (c) Normal               (d) None of these

4.  If X is exponentially distributed with parameter 3 then mean value is_____        CO6-U

    (a) 1/3                (b) 3                  (c) 1/9                  (d) None of these

5.  If E denotes the expectation the variance of a random variable X is denoted as?        CO6-U

    (a) $(E(X))^2$              (b) $E(X^2) - (E(X))^2$    (c) $E(X^2)$              (d) 2E(X)

6.  Var (2X + 3) = _____                                                          CO6-U

    (a) 4Var (X) + 9Var (Y)    (b) 4Var (X)        (c) 9Var (Y)            (d) 0

7.  Find the median for the following data 4, 6, 9, 4, 2, 8, 10                             CO6-U

    (a) 12                (b) 8                  (c) 6                    (d) 10

8.  The range of 25, 37, 11, 20, 14, 18, 16, 30, 35, 17.                                    CO6-U

    (a) 24                (b) 26                 (c) 29                   (d) 18

9.  The variable of t – distribution ranges from_____.                            CO6-U

    (a) > 0         (b) -∞ to ∞              (c) -∞ to 0              (d) None of these

10. In Chi-square the sample observations should be        CO6-U

    (a) Dependent                       (b) Independent

    (c) Coincide                          (d) None of these

<div align="center">PART – B (5 x 2= 10 Marks)</div>

11. A coin is tossed thrice. Find the probability that there will appear exactly two   CO6-U
tails?

12. If X is uniformly distributed over the interval [0, 8]. Compute P $(2 < X < 5)$.    CO6-U

13. If Correlation coefficient $\gamma = 0.4$, $\sigma_x = 5$, $\sigma_y = 2$, find the regression coefficient   CO6-U
of y on x.

14. Find the mean of the squares of first n natural numbers            CO6-U

15. Write down the formula of test Statistic 't' to test the significance of difference   CO6-U
between the means.

<div align="center">PART – C (5 x 16= 80 Marks)</div>

16. (a) (i) Three companies A, B and C supply 25%, 35% and 40% of the   CO1-App   (16)
notebooks to a school. Past experience shows that 5%, 4% and 2%
of the notebooks produced by these companies are defective. If a
notebook was found to be defective, what is the probability that the
notebook was supplied by A?

(ii) Using discrete random probability to find the value of 'K' if

$$p(x)= \begin{cases} Kx, & x = 1,2,3,4,5 \\ 0 & otherwise \end{cases}$$ represents p.m.f.

(i) Find $P\left(\dfrac{1}{2} < x < \dfrac{5}{2} \ / \ x > 1\right)$

(ii) Find the distribution function.

<div align="center">Or</div>

(b) (i) The time (in hours) required to complete a machine maintenance   CO1-App   (16)
task has cumulative distribution $F(x) = 1 - (1 + x)e^{-x}, x > 0$. Derive the
probability density function. Compute the expected time and
variance.

(ii) A production line may generate 1, 2, 3, or 4 defective items in a
shift. It is observed that $2P(X = 1) = 3P(X = 2) = P(X = 3) = 5P(X = 4)$. Find the probability distribution of defective counts.
Compute the expected number of defectives per shift and variance.

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17. (a) A customer help center receives on average 3.5 calls every hour.    CO2-App   (16)
(a) Using probability distribution of the Poisson distribution to find the moment generating function, (b) mean and variance of the number of mistakes, (c) What is the probability that it will receive at most 4 calls every hour? (d) What is the probability that it will receive at least 5 calls every hour?

Or

(b) (i) Using probability distribution of the uniform distribution to   CO2-App   (16)
explain M.G.F of uniform distribution and hence find mean and variance.
(ii) Buses arrive at a specified bus stop at 15-min intervals starting at 7 a.m. that is 7a.m., 7.15am, 7.30am… etc. If a passenger arrives at the bus stop at a random time which is uniformly distributed between 7am and 7.30 am. Find the probability that he waits (i) less than 5 min (ii) atleast 12 min for bus.

18. (a) (i) The joint distribution of X and Y is given by   CO3   –   (16)
$f(x, y) = \frac{x+y}{21}, x = 1, 2, 3; y = 1, 2$. Find the marginal distribution and   Ana
analyze the dependency between X and Y — are they independent? Justify mathematically.. Also find E (x), $E[xy]$.
(ii) The joint probability density function of a two dimensional random variable (X, Y) is given by

$f(x, y) = x^2 + \frac{xy}{3}; \quad 0 \le x \le 1; \quad 0 \le y \le 2$ .

Determine
(i) Marginal density function of X & Y (ii) Conditional distribution of Y on X (iii) Analyze the dependency between X and Y — are they independent? Justify mathematically.

Or

(b) Calculate the correlation coefficient of the following   CO3–Ana   (16)

| Height (cm) : X | 158 | 160 | 163 | 166 | 168 | 171 | 174 | 176 |
|---|---|---|---|---|---|---|---|---|
| Weight (kg) : Y | 60 | 62 | 64 | 65 | 67 | 69 | 71 | 72 |

Based on the value obtained, analyze the nature and strength of the relationship between height and weight. And also find Regression Equations x on y & y on x.

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19. (a) (i) Apply the appropriate formula for grouped data to compute the arithmetic mean, variance and mode of the following distribution:    CO4-App  (16)

| Marks | 0 – 8 | 8 – 16 | 16 – 24 | 24 – 32 | 32 – 40 | 40 – 48 |
|---|---|---|---|---|---|---|
| No. of students | 23 | 24 | 22 | 20 | 33 | 25 |

(ii) Using the grouped data quartile's formula, apply the computational steps to determine all quartile and quartile deviation for the dataset provided:

| Marks | 0 – 5 | 5 – 10 | 10 – 15 | 15 – 20 | 20 – 25 | 25 – 30 | 30 – 35 |
|---|---|---|---|---|---|---|---|
| No. of students | 5 | 12 | 21 | 22 | 13 | 10 | 7 |

Or

(b) (i) Apply the appropriate formula for grouped data to compute the arithmetic mean, variance and mode of the following distribution:    CO4-App  (16)

| Marks | 0 – 5 | 5 – 10 | 10 – 15 | 15 – 20 | 20 – 25 | 25 – 30 |
|---|---|---|---|---|---|---|
| No. of students | 20 | 25 | 27 | 13 | 17 | 10 |

(ii) Using the grouped data quartile's formula, apply the computational steps to determine all quartile and quartile deviation for the dataset provided:

| Marks | 0 – 10 | 10 – 20 | 20 – 30 | 30 – 40 | 40 – 50 | 50 – 60 |
|---|---|---|---|---|---|---|
| No. of students | 23 | 26 | 22 | 30 | 28 | 25 |

20. (a) (i) Analyze the differences in the sampling techniques used by Researchers X and Y. Based on the distribution of students across intelligence levels, determine which sampling technique appears to produce more variability and justify your reasoning using the given data.    CO5-Ana  (16)

| Research | Below Average | Average | Above Average | Excellent |
|---|---|---|---|---|
| X | 86 | 60 | 44 | 10 |
| Y | 40 | 33 | 25 | 2 |

(ii) Examine the pattern of aircraft accidents across the days per week 80 accidents. Identify any days that significantly deviate from the expected uniform pattern, and explain how these deviations could affect conclusions about accident risk throughout the week.

| Days | Mon | Tue | Wed | Thu | Fri | Sat |
|---|---|---|---|---|---|---|
| No. of accidents | 14 | 18 | 12 | 11 | 15 | 10 |

Or

(b) (i) A certain injection administered to each of 12 patients resulted in the following increases of blood pressure: 5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4. Classify the pattern of BP changes by separating positive, negative, and zero changes, and analyze how this distribution informs the question of whether the injection tends to increase BP.

(ii) In one sample of 10 observations, the sum of the squares of the deviations of the sample values from the sample mean was 120 and in another sample of 12 observations it was 314. Examine the ratio of the two variances and identify which statistical test (such as an F-test) is appropriate. Justify the choice by analysing assumptions such as normality and independence.

CO5-Ana    (16)

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