

3E1201

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B.Tech. III-Sem. (Main/Back) Examination, January - 2025**Artificial Intelligence and Data Science****3AID2-01 Advanced Engineering Mathematics****AID, CAI, CS, IT****Time : 3 Hours****Maximum Marks : 70****Instructions to Candidates:**

Attempt all ten questions from Part A, five questions out of seven questions from Part B and three questions out of five questions from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.

(Mentioned in form No.205)

PART - A

(Answer should be given up to 25 words only)

All questions are compulsory.

(10×2=20)

1. If X is a random variable such that $Var(X) = 5$, then what will be the value of $Var(2X + 10)$?
2. State Chebyshev's inequality.
3. Define Binomial distribution. What will be the value of p if the binomial distribution is symmetrical?
4. How many number of normal equations required for fitting a polynomial of $2m$ degree, by least square method?
5. Define the Spearman's formula for modified rank correlation coefficient for repeated rank.
6. What is the difference between linear and nonlinear programming problems?

7. State the necessary and sufficient conditions for the minimum of a function $f(x)$.

8. Consider the following problem:

$$\text{Minimize } z = f(X),$$

$$\text{Subject to } g_j(X) \leq 0; j=1,2,3,\dots, m.$$

Then write the suitable Kuhn—Tucker conditions.

9. Let m and n denote the numbers of equation and decision variables respectively, then what happens when $m = n$ in a Linear programming problem (LPP)?

10. What do you mean by the unbalanced transportation problem?

PART - B

(Analytical/Problem solving questions)

Attempt any Five questions.

(5×4=20)

1. Demonstrate the probability of not getting a 7 or 11 total on either of two tosses of a pair of fair dice.

2. If X is a continuous random variable whose pdf is given by

$$f(x) = \begin{cases} c(4x - 2x^2), & 0 < x < 2 \\ 0, & \text{otherwise} \end{cases}$$

Find (a) the value of c and (b) $P(X > 1)$.

3. Define exponential distribution, and show that the variance is squares the mean in exponential distribution.

4. Find the most likely price in Bombay corresponding to the price of Rs. 70 at Calcutta from the following:

	Calcutta	Bombay
Average price	65	67
Standard deviations	2.5	3.5

Correlation coefficient between the prices of commodities in the two cities is 0.8.

5. An animal food company must produce 200 kg of a mixture containing ingredients A and B daily. Ingredient A costs Rs. 3 per kg and B costs Rs. 8 per kg. No more than 80 kg of A can be used and at least 60 kg of B must be used. Find the mathematical model corresponding to the above problem.
6. Using the direct substitution method, find minimum value of $x^2 + y^2 + z^2$ when $ax + by + cz = p$.
7. Write the dual of the following problem:

$$\begin{aligned}
 \text{Min.} \quad & z = 2x_1 + x_2 \\
 \text{Subject to} \quad & 3x_1 + x_2 \geq 3 \\
 & 4x_1 + 3x_2 \geq 6 \\
 & x_1 + 2x_2 \geq 2 \\
 \text{and} \quad & x_1, x_2 \geq 0.
 \end{aligned}$$

PART - C

(Descriptive/Analytical/Problem Solving/Design question)

Attempt any Three questions.

(3×10=30)

1. X is normally distributed and the mean of X is 30 and standard deviation is 5. Find out the probability of the following:
- (a) $26 \leq X \leq 40$, (b) $X \geq 45$ and (c) $|X-30| > 5$.

Given that $P(0 < Z < 0.8) = 0.2881$.

2. Calculate the correlation coefficient for the following data:

x	65	66	67	67	68	69	70	72
y	67	68	65	68	72	72	69	71

3. What is optimization? Write a short note on the classification of optimization problems based on various parameters.

4. Minimize $f(X) = \frac{1}{2}(x_1^2 + x_2^2 + x_3^2)$

Subject to $g_1(X) = x_1 - x_2 = 0;$

$g_2(X) = x_1 + x_2 + x_3 - 1 = 0$

by Lagrange's multipliers method.

5. Using Big-M method, solve the following linear programming problem:

Max. $z = -2x_1 - x_2$

subject to $3x_1 + 4x_2 = 3$

$4x_1 + x_2 \geq 6$

$x_1 + 2x_2 \leq 4$

and $x_1, x_2 \geq 0.$
