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Roll No.

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3E1201

B.Tech. III-Sem (Main & Back) 2025-26
Artificial Intelligence
3CS2-01 Advanced Engineering Mathematics
AID,CAI,CS,IT,CCS, CDS,CIT,CSD,CSR,AI
3E1201

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)

1. NIL _____ 2. NIL _____

Part A

(Answer should be given up to 25 words only)

All questions are compulsory. **10 x 2 = 20**

- Q.1 ^{T-435} What is the difference between discrete and continuous random variables?
- Q.2 Write Chebyshev's inequality.
- Q.3 Define Poisson distribution, and write its mean and variables?
- Q.4 If $y = 3x + 10$ is the best fit for 5 pairs of values (x,y) , by least square method, and $\Sigma y = 200$; then what is the value of Σx ?
- Q.5 What is the difference between linear and nonlinear programming problems?
- Q.6 Match the following type of problems with their descriptions:
- | | |
|----------------------------------|---|
| A. Geometric programming problem | I. Classical Optimization problems |
| B. Quadratic programming problem | II. Objective and constraints are posynomials with positive coefficients ^{T-435} |

- C. Stochastic programming problem III. Objective is quadratic and constraints are linear
- D. Calculus of variations problem IV. Design variables are nondeterministic or probabilistic
- Q.7 What is Lagrangian function?
- Q.8 Consider the following problem :
Minimize $z = f(X)$,
Subject to $g_j(X) \leq 0$; $j = 1, 2, 3, \dots, m$.
Then write the suitable Kuhn-Tucker conditions.
- Q.9 What is difference between a slack and surplus variable?
- Q.10 Let m and n denotes the numbers of equation and decision variables respectively, then what happens when $m = n$ in a Linear programming problem (LPP)?

Part B

(Analytical/Problem solving questions)

Attempt any Five questions .

5x4=20

- Q.1 Suppose the life in hours of a certain kind of radio tube has the density.
$$f(x) = \frac{100}{x^2}, x \geq 100$$

and zero when $x \leq 100$. What is the probability that none of three such tubes in a radio set will have to be replaced during the first 150 hours of operation? What is the probability that all three of the original tubes will have been replaced during the first 150 hours?
- Q.2 If X is a normal variate with mean 8 and standard deviation 4, find $P(X < 5)$ and $P(5 < X < 10)$. Given from standard normal table that $\phi(0.5) = 0.1915$ and $\phi(0.75) = 0.2734$
- Q.3 Discuss the rank correlation coefficient for the data given below:
- | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| x | 78 | 89 | 97 | 69 | 59 | 79 | 68 | 57 |
| y | 125 | 137 | 156 | 112 | 107 | 136 | 123 | 108 |
- Q.4 A factory makes two products, A and B. Each unit of A requires 2 hours of machining and 1 hour of assembly. Each unit of B requires 1 hour of machining and 3 hours of assembly. The factory has at most

100 machining hours and 120 assembly hours per week. Profit per unit is Rs. 40 for A and Rs. 50 for B. Formulate the linear programming problem.

Q.5 Solve the constrained optimization problem.

$$\text{Min. } f(x, y) = x^2 + y^2, \quad x + y = 1$$

Q.6 Write the dual of the following linear programming problem.

$$\begin{aligned} \text{Maximize} \quad & z = x_1 + 4x_2 + 3x_3 \\ \text{Subject to} \quad & 2x_1 + 3x_2 - 5x_3 \leq 2, \\ & 3x_1 - x_2 + 6x_3 \geq 1, \\ & x_1 + x_2 + x_3 = 4 \\ \text{and} \quad & x_1, x_2, x_3 \geq 0 \end{aligned}$$

Q.7 Using North West Corner Rule, Determine an initial basic feasible solution of the following problem:

	D_1	D_2	D_3	D_4	a_i
O_1	6	4	1	5	14
O_2	8	9	2	7	16
O_3	4	3	6	2	5
b_i	6	10	15	4	35

Part C

(Descriptive/Analytical/Problem Solving/Design questions)

Attempt any Three questions .

3x10=30

- Q.1 (a) Derive moment generating function for exponential distribution, and hence find its mean and variance. <https://www.rtuonline.com>
- (b) Subway trains on a certain line run every half hour between mid-night and six in the morning. What is the probability that a man entering the station at a random time during this period will have to wait at least twenty minutes?

- Q.2 Given the following data on advertising expenditure (X) and sales (Y).
Fit a simple linear regression model of Y on X. Hence, estimate sales when advertising expenditure is Rs. 35,000.

X:	10	20	30	40	50
Y:	25	45	65	70	95

- Q.3 (a) What is optimization? Write its standard mathematical formulation.
(b) Give five applications of optimization in computer science and information technology.

- Q.4 Using Lagrange's multiplier method, solve the following problem.

$$\begin{aligned} \text{Max.} \quad & Z = 4x_1 - x_1^2 + 8x_2 - x_2^2 \\ \text{subject to} \quad & x_1 + x_2 = 4 \\ \text{and} \quad & x_1, x_2 \geq 0 \end{aligned}$$

- Q.5 Using the simplex method, solve the following LPP:

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