3E1201

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B. Tech. III - Sem. (Main / Back) Exam., February - 2023

Artificial Intelligence & 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 from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may 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) **[10×2=20]**

All questions are compulsory

Q.1 Find the value of the constant c such that the function $f(x) = \begin{cases} cx, 0 < x < 3 \\ 0, \text{Otherwise} \end{cases}$ is a probability density function.

Q.2 If E(X) = 4 and E(Y) = 1, then what is the value of E(2X + 3Y)?

Q.3 Define Binomial distribution and write its mean and variance.

Q.4 How many number of normal equations are required for fitting a polynomial of m degree, by least square method?

Q.5 What is optimization?

Q.6 What is the difference between linear and nonlinear programming problems?

Q.7 What is Lagrangian function?

Q.8 Under what circumstances can the condition $f'(x) = 0$ not be used to find the minimum of the function $f(x)$?

Q.9 If the given LPP has an optimal solution, then what about the solution of dual problem?

Q.10 For non-degenerate feasible solution of $m \times n$ transportation problem, how many independent individual positive assignments will be required?

PART – B

(Analytical/Problem solving questions) **[5×4=20]**

Attempt any five questions

Q.1 The distribution function for a random variable X is $F(x) = \begin{cases} 1 - e^{-2x}, & x \geq 0 \\ 0, & x < 0 \end{cases}$.

Find (a) the density function and (b) $P(-3 < X \leq 4)$.

Q.2 If X is uniformly distributed with mean 1 and variance 4/3, then estimate $P(X < 0)$.

Q.3 Discuss the rank correlation coefficient for the data given below –

x	10	12	15	14	19
y	40	41	48	60	50

Q.4 A company desires to devote the excess capacity of the three machines lathe, shaping and milling to make three products A, B and C. The available time per month in these machines are tabulated below –

Machine	Lathe	Shaping	Milling
Available time per month	200 hours	110 hours	180 hours

The time (in hours) taken to produce each unit of the products A, B and C on the machines is displayed in the table below –

Machine	Lathe	Shaping	Milling
Product A	5	2	4
Product B	2	2	Nil
Product C	3	Nil	3

The profit per unit of the products A, B and C are ₹ 20, ₹ 15 and ₹ 12 respectively. Formulate the mathematical model to maximize the profit.

Q.5 Find the maxima and minima of the function $u = x^3 + y^3 - 3x - 12y + 25$.

Q.6 Using Lagrange's multiplier method, solve the following problem -

Maximize $Z = 4x_1 - x_1^2 + 8x_2 - x_2^2$

Subject to $x_1 + x_2 = 4$

and $x_1, x_2 \geq 0$.

Q.7 Construct the dual of the following problem -

Minimize $Z = x_1 - 3x_2 + 3x_3$

Subject to $3x_1 - x_2 + 2x_3 \leq 7,\ 2x_1 - 4x_2 \geq 12,\ 4x_1 - 3x_2 - 8x_3 \geq 10$

and $x_1, x_2, x_3 \geq 0$.

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) **[3×10=30]**

Attempt any three questions

Q.1 Joint Distribution Function of two discrete random variable X and Y are given by $f(x, y) = c(2x + y)$, where x and y assumes all integer values such that $0 \le x \le 2$, $0 \le y \le 3$.

Find (i) c, (ii) $P(X = 2, Y = 1)$, (iii) $P(X \ge 1, Y \le 2)$, (iv) Marginal Distribution and (v) Check the dependency.

Q.2 Applying the theory of least square method, fit a second degree parabola to the following data -

x	0	1	2	3	4
y	1	5	10	22	38

Q.3 Write a short note on the classification of optimization problems based on various parameters.

Q.4 Using two phase simplex method, solve the following linear programming problem -

Min. $z = 2x_1 + 9x_2 + x_3$

Subject to $x_1 + 4x_2 + 2x_3 \ge 5$

$3x_1 + x_2 + 2x_3 \ge 4$

and $x_1, x_2, x_3 \ge 0.$

Q.5 Solve the following transportation problem -

		1	2	3	Available
From	I	2	7	4	5
	II	3	3	7	8
	III	5	4	1	7
	IV	1	6	2	14
Requirement		7	9	18	
