**Printed Page:-05** **Subject Code:- BAS0404**

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**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**

**(An Autonomous Institute Affiliated to AKTU, Lucknow)**

**B.Tech**

**SEM: IV - THEORY EXAMINATION (2024 - 2025)**

**Subject: Optimization and Numerical Techniques**

**Time: 3 Hours** **Max. Marks: 100**

**General Instructions:**

**IMP:** *Verify that you have received the question paper with the correct course, code, branch etc.*

***1.*** *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

***2.*** *Maximum marks for each question are indicated on right -hand side of each question.*

***3.*** *Illustrate your answers with neat sketches wherever necessary.*

***4.*** *Assume suitable data if necessary.*

***5.*** *Preferably, write the answers in sequential order.*

***6.*** *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

**SECTION-A** 20

1. Attempt all parts:-

1-a. If an optimal solution is degenerate, then (CO1, K1) 1

(a) There is alternative optimal solution

(b) There is no feasible solution

(c) The solution is of no use for decision maker

(d) None of these

1-b. The method used to solve Linear Programming Problem with use of the artificial variable is called _____.(CO1, K1) 1

(a) Simplex Method

(b) Big-M Method

(c) Dual Simplex Method

(d) Graphical Mehtod

1-c. In a branch and bound problem , if X= 5, and Y= 3.5, which of the following would be a possible branching option. (CO2, K1) 1

(a) $y \geq 4$

(b) $x \leq 5$

(c) $x \geq 5$

(d) $y \leq 4$

1-d. The ..... problem is an example of a 0-1 programming problem. (CO2,K1) 1

(a) Transportation problem

(b) Assignment problem
(c) Product mix
(d) All of the above

1-e. The intersection of two convex sets is always (CO3, K1) 1

(a) Concave
(b) Convex
(c) Both concave and convex
(d) None of the above

1-f. Minimum values of $f(x_1,x_2)=x_1^2+x_2^2+6x_1+12$ is (CO3,K1) 1

(a) 3
(b) 0
(c) 10
(d) None of these

1-g. Rate of convergence of Regula-falsi is (CO4, K1) 1

(a) Linear
(b) Quadratic
(c) 1.618
(d) None of these

1-h. At which point the iterations in the Newton Raphson method are stopped? (CO4, K1) 1

(a) When the consecutive iterative values of x are not equal
(b) When the consecutive iterative values of x differ by 2 decimal places
(c) When the consecutive iterative values of x differ by 3 decimal places
(d) When the consecutive iterative values of x are equal

1-i. A train covers a distance of 12 km in 10 minutes. If it takes 6 seconds to pass a telegraph post, then the length of the train is (CO5, K1) 1

(a) 90 m
(b) 100 m
(c) 120 m
(d) None of these

1-j. 1

$123 : 13^2 :: 235 : ?$ (CO5, K1)

(a) $23^2$
(b) $35^2$
(c) $25^3$
(d) $25^2$

2. Attempt all parts:-

.

2.a. Write the dual equation to the following LPP: 2

Min. $Z = 10x_1 + 15x_2$

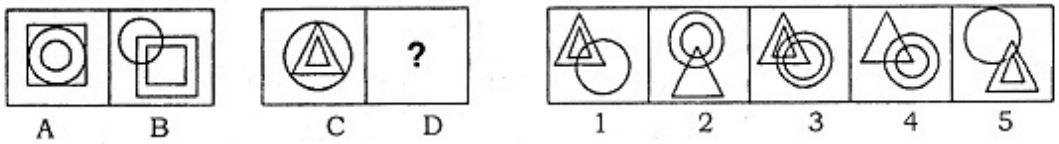
Subject to constraints: $5x_1 + 7x_2 \geq 80,\ 6x_1 + 11x_2 \geq 100,\ x_1, x_2 \geq 0$ ( CO1,K1)

2.b. Write initial steps of algorithm for cutting plane method.(CO2, K1) 2

2.c. Show that the set $C = \{(x_1,x_2): 2x_1 + 3x_2 \subset R^2\}$ is a convex set. (CO3, K1) 2

2.d. Use Trapezoidal rule to evaluate $\int_0^1 x^3 dx$ considering five sub intervals. (CO4, K3) 2

2.e. Find D and justify your answer for the following analogy. (CO5, K3) 2




**SECTION-B** 30

3. Answer any five of the following:-

3-a. A factory manufactures two products A and B. To manufacture one unit of A, 1.5 machine hours and 2.5 labour hours are required. To manufacture product B, 2.5 machine hours and 1.5 labour hours are required. In a month, 300 machine hours and 240 labour hours are available. Profit per unit for A is Rs. 50 and for B is Rs. 40. Formulate as LPP. (CO1, K3) 6

3-b. Solve the following LPP by graphical method (CO1,K3) 6

Maximize Z = 7X + 5Y

subject to $4X + 3Y \leq 240$

$2X + Y \leq 100$

$X \geq 0, Y \geq 0$ .

3-c. Discuss zero one programming problem and give its applications. (CO2, K1) 6

3-d. Explain the drawbacks of using branch and bound method. (CO2, K1) 6

3.e. Show that the set $S = \{x: x = (x_1,x_2,x_3),\ x_1^2 + x_2^2 + x_3^2 \leq 1\}$ is a convex set. (CO3,K1) 6

3.f. Find a root of the equation with bisection method $f(x) = x^2 - 3$ in the interval [1, 2] correct up to 4 decimal places. (CO4, K3) 6

3.g. A, B and C can complete a piece of work in 15, 12, 10 days respectively. A and B started the work together and left after 4 days. If the remaining work can be done by C, then in how many days the total work gets completed? (CO5, K3) 6

**SECTION-C** 50

4. Answer any one of the following:-

4-a. Use simplex method to solve the LPP. (CO1, K3) 10

Min $Z = x_1 - 3x_2 + 2x_3$

subject to

$3x_1 - x_2 + 2x_3 \leq 7$

$-2x_1 + 4x_2 \leq 12$

$-4x_1+3x_2+8x_3 \leq 10$

$x_1, x_2, x_3 \geq 0$

4-b. Use two − phase simplex method to solve, (CO1, K3) 10

Max $Z = 5x_1 + 3x_2$

Subject to

$2x_1 + x_2 \leq 1$

$x_1 + 4x_2 \geq 3$

$x_1, x_2 \geq 0$

5. Answer any <u>one</u> of the following:-

5-a. Solve the following integer programming problem using cutting plane procedure (CO2, K3) 10

Max. Z = 3x + 2y

s.t.

$x - y \leq 3$

$x + 2y \leq 2$

$x \geq 0$ and y is an integer.

5-b. Solve the following integer programming problem by using branch and bound method: (CO2, K3) 10

Max. Z = 2x + 3y

s.t.

$x + y \leq 35$

$4x + 9y \leq 36$

$x, y \geq 0$ and are integers.

6. Answer any <u>one</u> of the following:-

6-a. Use the Lagrange's multipliers to solve the following non-linear programming problem. Does the solution maximize or minimize the objective function? (CO3, K3) 10

Max $Z = 2x^2 + y^2 + 3z^2 + 10x + 8y + 6z - 100$

subject to

$x + y + z = 20$

$x, y, z \geq 0$

6-b. Examine the function $Z(x,y) = x^2y - y^2x - x + y$ for maxima and minima. Find the saddle points of the given surface. (CO3, K3) 10

7. Answer any <u>one</u> of the following:-

7-a. Use Newton's divided difference formula to find the interpolation polynomial and hence evaluate y(9.5) from the given data: (CO4, K3) 10

| x | 7 | 8 | 9 | 10 |
|---|---|---|---|---|
| y | 3 | 1 | 1 | 9 |

7-b. Solve the following system of equation by Gauss- Elimination method (CO4, K3) 10

$2x-3y+4z = 7$; $5x-2y+2z = 7$; $6x-3y+10z = 23$

8. Answer any <u>one</u> of the following:-

8-a. Read the information given below and answer the following questions: 10

A total of 10 people, 5 men and 5 women are sitting in two parallel lines, facing each other. Five men, namely, Ajit, Bharat, Chirag, Dharam and Ejaz are facing to the south and the five women, Meenal, Neelu, Octavia, Preeti and Arpita are facing towards the north.

Bharat, who is just next to the left of Dharam, is opposite to Arpita.

Chirag and Neelu are diagonally opposite to each other.

Ejaz is opposite Octavia who is just next to Meenal.

Preeti, who is just to the left of Arpita, is opposite to Dharam.

Meenal is at one end of the line

I. Which two people are sitting at the two extreme right ends of the line?
II. Who is sitting in front of Dharam?
III. Who sits exactly in between Meenal and Preeti?
IV. Who sits opposite to Octavia?
V. Who is sitting at the left corner of the men's line? (CO5, K3)

8-b. (a). A beats B by 24 m and C by 20 m, C beats B by 1 sec in a race of 120 m. In how many seconds does A completes the race? 10

(b). Two cyclist A and B cover a distance of 110 km, A reaches to the destination one hour before B. Even if B had given a start of 8 km, he would have reached 12 minutes late. Find the speed of A. (CO5,K3)