BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – B.Tech.(CSE)-DS-2022
Course Name – Operational Research
Course Code - OEC-CSD601C
(Semester VI)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A
(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Select the correct option. In the optimum solution, if a primal variable is basic then the corresponding dual slack value is ___
   a) Positive
   b) Negative
   c) Zero
   d) Can't be said.

(ii) Consider the maximum flow problem with n nodes and m arcs. You are writing a formulation with f as the maximum flow. Identify the correct option. The total number of constraints is _____
   a) m
   b) n
   c) m+n
   d) m.n

(iii) Define the primary objective of formulating a Linear Programming Problem.
   a) To maximize or minimize a linear objective function subject to linear constraints.
   b) To solve complex mathematical equations
   c) To analyze non-linear systems
   d) To optimize quadratic functions.

(iv) Select the correct option. The scientific method in Operations Research consists of
   a) Judgement phase
   b) Research phase
   c) Action phase
   d) All of these

(v) Consider the LP problem:
Maximize $5X_1 + 8X_2$
subject to
$3X_1 + 4X_2 \leq 16$
$5X_1+2X_2 \leq 12$
$X_1, X_2 \geq 0$
Identify the corner point obtained by solving $3X_1+4X_2=16$ and $5X_1+2X_2=12$ is
   a) (8/7, 22/7)
   b) (7/8, 22/7)
   c) (8/7, 7/22)
   d) (7/8, 7/22)

(vi) Consider the LP problem:

Maximize $7x + 6y$

Subject to

$x + y \leq 4$

$2x + y \leq 6$

and $x, y \geq 0$

Solve by algebraic method and answer the following:

The number of basic solutions is ____

a) 1
b) 4
c) 2
d) 6

(vii) Consider the LP problem:

Maximize $7X_1 + 6X_2$

subject to $X_1 + X_2 \leq 4$

$2X_1 + X_2 \leq 6$

$X_1, X_2 \geq 0.$

Solve by algebraic method and answer the following:

If we solve for X1 and X2 as basic, the value of X2 is _____

a) 0
b) 1
c) 2
d) 4

(viii) Consider the napkins problem where the requirement is for 20 days. There are two types of laundries – fast and slow. The fast laundry takes 2 days (napkins sent at the end of day 1 can be used on day 3) and the slow laundry takes 3 days (napkins sent at the end of day 1 can be used on day 4). The costs of the new napkins and the two laundries are known. Identify the correct option. The total number of variables in the formulation is _____

a) 56
b) 58
c) 55
d) 53

(ix) Consider the media selection problem with n possible things to invest in. Examples could be TV, radio, newspaper etc. There is a total budget restriction and limit on investment in each. Choose the correct option. The objective function has _____ terms

a) n
b) n+1
c) n+2
d) n-1

(x) Consider the media selection problem with n possible things to invest in. Examples could be TV, radio, newspaper etc. There is a total budget restriction and limit on investment in each. Choose the correct option. The number of decision variables is _____

a) n-1
b) n-2
c) n
d) n+1

(xi) Consider the LP problem

Minimize $3X_1 + 8X_2 + 3X_3 + 7X_4$

subject to $3X_1 + 5X_2 + X_3 \geq 16;$

$5X_1 + 3X_2 - X_4 \geq 12,$

$X_1, X_2, X_3, X_4 \geq 0.$

Identify the correct option. The number of artificial variables required to initialize the simplex table is ___

a) 1
b) 2
c) 3
d) 4

(xii) Consider the LP problem

Minimize $3X_1 + 8X_2$

subject to

$3X_1 + 5X_2 \geq 16$

$5X_1 + 3X_2 \geq 12$

$X_1, X_2 \geq 0.$

Select the correct option. The number of variables in the simplex table for this problem is ____.

a) 4 b) 5
c) 6 d) 7

(xiii) Solve the LP problem using Simplex algorithm

Minimize 2X1 + 3X2

subject to

X1 + X2 ≥ 4

X1 ≤1

X1, X2 ≥ 0 and identify the correct option.

The value of the objective function at the optimum is _____

a) 7 b) 9
c) 10 d) 11

(xiv) Identify the correct option. The primal has m constraints and n variables. The dual has ___ constraints and ___variables.

a) m, m b) n, n
c) m, n d) n, m

(xv) Determine the correct one-----Alternative solution exists of an LPP, when

a) one of the constraints is redundant b) two of the constraints are parallel
c) objective function equation is parallel to one of the constraints d) all of these.

Group-B
(Short Answer Type Questions) 3 x 5=15

2. Define Operations Research and its importance. (3)

3. Discuss any three advantages of using models in Operations Research. (3)

4. Identify the solution of the following linear programming problem by graphical method. (3)

$$\text{Max } Z = 100x + 100y.$$

$$\begin{aligned} \text{Sub to : } & 10x + 5y \leq 80 \\ & 6x + 6y \leq 66 \\ & 4x + 8y \geq 24 \\ & 5x + 6y \leq 90 \\ & x, y \geq 0 \end{aligned}$$

5. Examine the solution of the following linear programming problem by Graphical method (3)

Maximize $z = -x + y$

subject to: $3x + y \geq 6$
$2x + y \leq 3$
$x, y \geq 0$

6. A shop can make two types of sweets (A and B). They use two resources – flour and sugar. To Make one packet of A, they need 2 kg of flour and 5 kg of sugar. To make one packet of B, they need 3 kg of flour and 3 kg of sugar. They have 25 kg of flour and 28 kg of sugar. These sweets are sold at Rs 800 and 900 per packet respectively. Find the best product mix. Formulate the appropriate LPP. (3)

OR

Test if the following LPP has a feasible solution: (3)

Maximize

$Z=2x+3y$

Subject to:

$x+y\leq 4,$

$2x+2y\geq 10,$

$x\geq 0, y\geq 0.$

Group-C

(Long Answer Type Questions) 5 x 6=30

7. A manufacturer produces two types of chairs: wooden and plastic. Each wooden chair requires 3 hours of carpentry work and 2 hours of polishing, while each plastic chair requires 2 hours of carpentry work and 1 hour of polishing. The company has 18 hours of carpentry work and 10 hours of polishing available per day. The profit per wooden chair is ₹50, and for a plastic chair, it is ₹40. Deduce the optimal solution of the LPP graphically to maximize profit. (5)

8. (5)

Identify the optimal solution the following LPP by using two phase simplex method

$Max\ z=5x_1+8x_2$

Subject to

$3x_1+2x_2\geq 3$

$x_1+4x_2\geq 10$

$x_1+x_2\leq 5$

$x_1,x_2\geq 0$

9. Illustrate the dual of the following problem: (5)

$Maximize\ z=3x_1+x_2+2x_3-x_4$

Subject to

$2x_1-x_2+3x_3+x_4=1$

$x_1+x_2-x_3+x_4=3$

$x_1,x_2\geq 0$ *and* x_3,x_4 are unrestricted in sign. Show further that the dual of the dual problem is primal.

10. Given the constraints: (5)

$2x+y\leq 10,$

$x+3y\leq 15,$

$x, y\geq 0$

Estimate the feasible region and evaluate the corner points. Also, test if the function $Z=4x+3y$ attains its maximum at any of these points.

11. Estimate the optimal solution of the following L.P.P by applying the Charne's Big-M method: (5)

Min $z = 4x_1 + x_2$

Subject to the constraint

$3x_1 + x_2 = 3$
$4x_1 + 3x_2 \geq 6$
$x_1 + 2x_2 \leq 4$
for $x_1, x_2 \geq 0$

12. A firm makes two types of furniture – chairs and tables. The profit for each product as calculated by the accounting department is Rs. 20 per chair and Rs.30 per table. Both products are to be processed on three machines M_1, M_2, M_3. The time required in hours by each product and total time available in hours per week on each machine is as follows: (5)

Machine	Chair	Table	Available Time(hrs)
M_1	3	3	36
M_2	5	2	50
M_3	2	6	60

Construct the mathematical formulation to this linear programming problem to maximize the profit.

OR

Express the limitations of Linear Programming. (5)

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