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Unique Paper Code   : 236151

Name of the Paper   : Operational Research -1
                         (Linear Programming)

Name of the Course   : B.A. (Programme) – Operational Research

Semester   : 1

Duration   : 3 hours

Maximum Marks   : 75 Marks

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any five questions.
3. All questions carry equal marks.
4. Simple calculators are allowed.
5. Graph paper can be used.

1. (a) Discuss the importance of operational research in decision making. (5)

   (b) Define the following: (6)
       (i) Extreme Point
       (ii) Hyper plane
       (iii) Linearly independent set of vectors

   (c) Define a convex set and examine the convexity of the set: (4)

   $$S = \{(x_1, x_2): x_1^2 + x_2^2 \leq 1\}$$

2. (a) Prove that an optimal solution of a LPP occurs at one of the extreme points of convex region formed by the feasible solutions of a LPP. (7)

   (b) A company has two bottling plants, located at two different places. Each plant produces three different drinks A, B and C. The capacity of two plants, in number of bottles per day is as follows:

	Product A	Product B	Product C
Plant I	3000	1000	2000
Plant II	1000	1000	6000

   A market survey indicates that during any particular month there will be a demand of 24000 bottles of A, 16000 bottles of B and 48000 bottles of C. The operating costs per day of running plants I and II are Rs. 600 and Rs.400 respectively. How many days should the company run each plant during the month so that the production cost is minimized while still meeting the market demand? (Use Graphical Method) (8)

3. (a) Find all possible basic solutions for the following set of linear equations: (6)

   $$x_1 + 2x_2 + x_3 = 4$$
   $$3x_1 + x_2 + 5x_3 = 5$$

   (b) Find the inverse of A=$\begin{pmatrix} 3 & 2 \\ 1 & 2 \end{pmatrix}$ using Simplex method. (6)

   (c) Define Slack, Surplus and Artificial variables. (3)

4. (a) In the context of linear programming, what do you understand by
   (i) Multiple Solutions
   (ii) Unbounded optimal solution.
   How would you recognize these in the optimal simplex tableau? (7)

   (b) Use two phase method to solve the following LPP. (8)
   $$Max Z = 3x_1 + 2x_2 + 3x_3$$
   Subject to
   $$2x_1 + x_2 + x_3 \leq 2$$
   $$3x_1 + 4x_2 + 2x_3 \geq 8$$
   $$x_1, x_2, x_3 \geq 0$$

5. (a) Write the dual of the following LPP. (7)
   $$Min Z = 5x_1 + 6x_2 + x_3$$
   Subject to
   $$x_1 + 2x_2 + x_3 = 15$$
   $$-x_1 + 5x_2 \leq 18$$
   $$4x_1 + 7x_2 \leq 20$$
   $$x_1, x_2 \geq 0, x_3 \text{ unrestricted}$$

   (b) State and prove complementary slackness theorem in Linear programming (8)

6. (a) A company has 3 factories F1, F2 and F3, which supply the warehouses W1, W2, W3 and W4 . Weekly factory capacities are 700, 400 and 800 units respectively. Weekly warehouse requirements are 200,600,700 and 400 units respectively. Unit transportation costs are as follows:

		Factory	
Warehouses	F1	F2	F3
W1	5	8	12
W2	7	6	10
W3	13	14	9
W4	10	13	11

   Determine the optimal distribution schedule for this company to minimize total transportation cost. (8)

   (b) How the problem of degeneracy arises in transportation problem? Explain how does one overcome it? (7)

7. (a) The owner of a machine shop has four machines. Five jobs are offered with expected profit for each machine on each job are as follows:

Jobs

		A	B	C	D	E
	1	62	78	50	101	82
Machines	2	71	84	61	73	59
	3	87	92	111	71	81
	4	48	64	87	77	80

Find the optimal allocation plan of machines to jobs that maximizes profit. Which job offer will be turned down. (10)

(b) Write short notes on any two of the following: (5)
   (i) Economic Interpretation of Duality
   (ii) Big-M method
   (iii) Primal Dual Relationship