This question paper contains 4+1 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **86**

Unique Paper Code : **236151** E

Name of the Paper : **Linear Programming**

Name of the Course : **B.A. (Programme) Operational Research-I**

Semester : I

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Answer any *five* questions.

All questions carry equal marks.

Simple calculators are allowed.

Graph paper can be used.

1. (*a*) Define Operational Research. Discuss its significance and scope in decision-making. Also the limitations if any. 2+3+2

(*b*) Define a convex set. Show that :

$$S = \{(x_1, x_2, x_3) : 2x_1 - x_2 + x_3 \leq 4\} \subset R^3$$

is a convex set. 2+6

P.T.O.

2. (*a*) Define the following : 5×1.5

(*i*) Hyperplane

(*ii*) Extreme points

(*iii*) Basic feasible solution

(*iv*) Optimum basic feasible solution

(*v*) Linear dependence of vectors.

(*b*) Find all the basic feasible solutions to the following system of linear equation : 7.5

$$2x_1 + 6x_2 + 2x_3 + x_4 = 3$$

$$6x_1 + 4x_2 + 4x_3 + 6x_4 = 2.$$

3. (*a*) Solve the following transportation problem : 10

From	To			
	A	B	C	Available
I	50	30	220	1
II	90	45	170	3
III	250	200	50	4
Requirements	4	2	2	

(*b*) Solve the following assignment problem : 5

		Jobs			
		A	B	C	D
Workers	I	18	26	17	11
	II	13	28	14	26
	III	38	19	18	15
	IV	19	26	24	10

4. (*a*) A firm manufacturers two products A and B on which the profits earned per unit are Rs. 3 and Rs. 4 respectively. Each product is processed on two machines M_1 and M_2. Product A requires one minute of processing time on M_1 and two minutes on M_2 while B requires one minute on M_1 and one minute on M_2. Machine M_1 is available for not more than 7 hours and 30 minutes, while machine M_2 is available for 10 hours during any working day. Formulate the problem that maximizes the total profit of the firm. 5

(*b*) Use graphical method to solve the following LPP :

(*i*) Max. $z = 2x_1 + 2x_2$

Subject to :

$$x_1 - x_2 \geq -1$$

$$-0.5x_1 + x_2 \leq 2$$

$$x_1, x_2 \geq 0.$$

(*ii*) Max. $z = 3x_1 - 2x_2$

Subject to :

$$x_1 + x_2 \leq 1$$

$$2x_1 + 2x_2 \geq 4$$

$$x_1, x_2 \geq 0.$$ 5+5

5. Using artificial variable technique solve the following LPP :

Max. $z = 6x_1 + 4x_2$

Subject to :

$2x_1 + 3x_2 \leq 30,$

$3x_1 + 2x_2 \leq 24,$

$x_1 + x_2 \geq 3$

x_1 and $x_2 \geq 0.$

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6. (*a*) Explain the two phase method for solving a linear programming problem. 6

(*b*) What conditions must exist in a simplex table to establish the existence of unbounded solution and degeneracy ?

2+2

(*c*) Rewrite the following linear programming problem to its standard form :

Max. $z = 4x_1 + 5x_2 + 9x_3 + 11x_4$

Subject to :

$x_1 + x_2 + x_3 + x_4 \leq 15$

$7x_1 + 5x_2 + 3x_3 + 2x_4 \leq 120$

$3x_1 + 5x_2 + 10x_3 + 15x_4 \leq 100$

$x_1, x_2 \geq 0$, x_3 and x_4 are unrestricted in sign.

5

7. (*a*) What is duality in linear programming problem ? Give the economic interpretations of the dual variables. 2+5

(*b*) Write the dual to the following LPP :

Max. $z = 2x_1 + 3x_2 + 4x_3$

Subject to :

$2x_1 + 3x_2 + 5x_3 \geq 2$

$3x_1 + x_2 + 7x_3 = 3$

$x_1 + 4x_2 + 6x_3 \leq 5$

$x_1, x_2 \geq 0$ and x_3 are unrestricted. 8