[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 5006 **D** **Your Roll No.....**

Unique Paper Code : 236162

Name of the Course : **B.Sc. Mathematical Sciences**

Name of the Paper : Operational Research – I (Linear Programming)

Semester : I

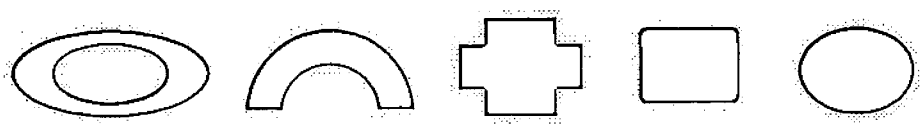
Time : 3 Hours Maximum Marks : 75

Instructions for Candidates

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

1. (a) Define Operational Research (OR) ? What is a model in OR ? Explain briefly the general method for solving an OR model. (2+2+4)

   (b) What is a convex set ? Examine whether the following figures forms a convex set or not. Explain your answer. (2+5)



2. (a) Define the following :

   (i) Hyperplane

   (ii) Extreme points

   (iii) Basic feasible solution

   (iv) Slack and surplus variables (2×4=8)

P.T.O.

(b) Obtain all the basic solutions to the following system of linear equation :

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

$$2x_1 + x_2 + 5x_3 = 5 \qquad (7)$$

3. (a) A company manufactures two kinds of machines, each machine requiring a different manufacturing technique. The deluxe machine requires 18 hours of labour, 8 hours of testing and yields a profit of Rs. 400. The standard machine requires 3 hours of labour, 4 hours of testing and yields a profit of Rs. 200. There are 800 hours of labour and 600 hours of testing available each month. A marketing forecast has shown that the monthly demand for the standard machine is to be more than 150. The management wants to know the number of each model to be produced monthly that would maximize the total profit. Formulate and solve this as a linear programming problem using graphical method. (10)

(b) Give a rough graphical representation of the following cases in a LPP :

(i) Infeasible solution

(ii) Unbounded solution (2.5+2.5)

4. (a) Define artificial variable and its use in linear programming. (5)

(b) What conditions must exist in a simplex table to establish the existence of infeasible solution ? Solve the following linear programming problem :

Max $z = 6x_1 + 4x_2$

Subject to :

$$x_1 + x_2 \leq 5$$

$$x_2 \geq 8$$

$$x_1, x_2 \geq 0 \qquad (2+8)$$

5. (a) Explain degeneracy in linear programming ? How can this be resolved ? (2+4)

(b) Solve the following linear programming problem :

Max $z = 3x_1 + 9x_2$

Subject to :

$$x_1 + 4x_2 \leq 8$$

$$x_1 + 2x_2 \leq 4$$

and $x_1, x_2 \geq 0$ (9)

6. (a) Determine the initial basic feasible solution to the following transportation problem using North-West Conner Rule, Least Cost Method and Vogel's Approximation Method. (3×3)

	D_1	D_2	D_3	D_4	**Supply**
S_1	21	16	15	3	11
S_2	17	18	14	23	13
S_3	32	27	18	41	19
Demand	6	10	12	15	

(b) A department of a company has five employees with five jobs to be performed. The time (in hours) that each man takes to perform each job is given in the effectiveness matrix. (6)

Employees

Jobs	I	II	III	IV	
A	10	5	13	15	16
B	3	9	18	13	6
C	10	7	2	2	2
D	7	11	9	7	12
E	7	9	10	4	12

Assign the different jobs to the different employee in such a way that the total cost is minimum.

P.T.O.

7. (a) Write the dual of the following linear programming problem :

Max $Z = 6x_1 + 4x_2$

Subject to constraints :

$$2x_1 + 3x_2 \leq 30$$

$$3x_1 + 2x_2 \leq 24$$

$x_1 + x_2 \geq 3$, $x_1 \geq 0$ and x_2 unrestricted. (6)

(b) State the weak and strong duality theorem. Also give the economic interpretation of duality. (2+2+5)