

This question paper contains 6 printed pages.

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Your Roll No.

MEM

J

Paper – ME.554

OPERATIONS RESEARCH – I

Time : 3 hours

Maximum Marks : 100

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

*Answer any five questions.
Assume missing data, if any.*

1. (a) Illustrate graphically the following special cases of LP problems:

(i) Infeasible solution

(ii) Unbounded solution

(iii) Multiple optimal solutions.

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(b) Use penalty method to minimize

$$z = x_1 + 2x_2 + x_3$$

subject to

$$x_1 + \frac{1}{2}x_2 + \frac{1}{2}x_3 \leq 1$$

$$\frac{3}{2}x_1 + 2x_2 + x_3 \geq 8$$

$$x_1, x_2, x_3 \geq 0.$$

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2. What do you mean by degeneracy in Simplex Method?
Solve the following problem by Simplex Method:

Maximize $z = 2x_1 + x_2$
subject to

$$x_1 + 2x_2 \leq 10$$

$$x_1 + x_2 \leq 6$$

$$x_1 - x_2 \leq 2$$

$$x_1 - 2x_2 \leq 1$$

$$x_1, x_2 \geq 0.$$

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3. Write different rules for constructing the dual from primal.

A firm manufactures two products A and B on machines I and II as shown below:

Machine	Product		Available Hours
	A	B	
I	30	20	300
II	5	10	110
Profit per unit (Rs.)	6	8	

The total time available is 300 hours and 110 hours on machines I and II respectively. Products A and B contribute Rs. 6 and Rs. 8 per unit respectively. Determine the optimum product mix. Also verify the solution from the dual of the LP problem.

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4. A product is produced by four factories A, B, C and D. The unit production costs in them are Rs. 2, 3, 1 and 5 respectively. Their production capacities are factory A- 50 units, B- 70 units, C- 30 units and D- 50 units. These factories supply the product to four stores, demands for which are 25, 35, 105 and 20 units respectively. Unit transport cost in Rs. from each factory to each store is given in Table - 1.

Determine the extent of deliveries from each of the factories to each of the stores so that the total production and transportation cost is the minimum. Also apply the optimality test for the solution.

Table - 1

	1	2	3	4	Supply
A	2	4	6	11	50
B	10	8	7	5	70
C	13	3	9	12	30
D	4	6	8	3	50
Demand	25	35	105	20	

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- (b) Four different jobs can be done on four different machines. The set-up and take-down time costs are assumed to be prohibitively high for change-overs. The matrix below (Table - 2) gives the cost in rupees of producing job i on machine j :

Table - 2

	M_1	M_2	M_3	M_4
J_1	5	7	11	6
J_2	8	5	9	6
J_3	4	7	10	7
J_4	10	4	8	3

How should the jobs be assigned to the various machines so that the total cost is minimized? 8

5. (a) Discuss different characteristics of Queuing System. Explain different Kendall's notation used for representing the Queuing Model. 10
- (b) A self service store employs one cashier at its counter. Eight customers arrive on an average five minutes while the cashier can serve 10 customers in the same time. Assuming Poisson distribution for arrival and exponential distribution for service rate, determine:
- Average number of customers in the system
 - Average number of customers in queue
 - Average time a customer spends in the system
 - Average time a customer waits before being served. 10

6. (a) Define following terms of Game theory:

(i) Competitive game

(ii) Payoff matrix

(iii) Pure and mixed strategies

(iv) Saddle point

(v) Two person zero sum game. 10

(b) A cast iron bracket has a demand of 9000 units per year. The cost of one procurement is Rs. 100 and the holding cost per unit is Rs. 2.40 per year. The replacement is instantaneous and no shortage is allowed.

Determine:

(i) The economic lot size

(ii) The number of orders per year

(iii) The time between orders

(iv) Minimum total variable yearly cost

(iv) The total cost per year if Rs. 3 is the cost of one unit. 10

7. The owner of a readymade garments store sells two types of shirts— Zee shirts and Button-down shirts. He makes a profit of Rs. 3 and Rs. 12 per shirt on Zee shirts and Button-down shirts, respectively. He has two tailors, A and B at his disposal to stitch the
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shirts. Tailors A and B can devote at the most 7 hours and 15 hours per day respectively. Both these shirts are to be stitched by both the tailors. Tailors A and B spend 2 hours and 5 hours, respectively in stitching one Zee shirt, and 4 hours and 3 hours, respectively in stitching a Button-down shirt. How many shirts of both types should be stitched in order to maximize daily profit?

- (a) Formulate and solve this problem as an LP problem.
- (b) If the optimal solution is not integer valued, use Gomory technique to derive the optimal integer solution.

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