(6 pages)

MAY 2016 **P/ID 77815/PMSL5**

Time : Three hours Maximum : 100 marks

PART A — (5 × 6 = 30 marks)

Answer any FIVE questions.

1. How will you formulate transportation problem as linear programming model'?
2. What are the types of transportation problem? Illustrate them with examples.
3. Discuss the need for integer programming using a suitable example.
4. Give a mathematical model for assignment problem.
5. What is separable programming? Discuss its merits.
6. Discuss the applications of non-linear programming in business.
7. List and explain the terminologies of dynamic programming.
8. Explain the following.
   (a) Balking
   (b) Jockeying
   (c) Reneging

PART B — (5 × 10 = 50 marks)

Answer any FIVE questions.

9. Solve the following LP problem using two phase method.

Minimum $Z = 10x_1 + 6x_2 + 2x_3$

Subject to

$-x_1 + x_2 + x_3 \geq 1$

$3x_1 + x_2 - x_3 \geq 2$

$x_1 + x_2$ and $x_3 \geq 0$

10. A company has plants at A, B and C which have capacities to produce 300kg, 200kg and 500kg. respectively of a particular chemical per day. The production costs (per kg.) in these plants are Rs.70. Rs.60 and Rs.66. respectively. Four bulk consumers have placed orders for the product on the following basis.

Consumer	Kg required per days	Price offered (Rs./Kg)
I	400	100
II	250	100
III	350	102
IV	150	103

Shipping costs (in rupees per kg) from plants to consumers are given in the table below.

		To			
		I	II	III	IV
From	A	3	5	4	6
	B	8	11	9	12
	C	4	6	2	8

Find the optimal schedule for the above situation.

11. Solve the following integer programming problem optimally.

Maximize $Z = 2x_1 + 5x_2$

Subject to

$3x_1 + 6x_2 \leq 24$

$6x_1 + 12x_2 \leq 18$

$2x_1 + 8x_2 \leq 20$

$x_1, x_2 \geq 0$ and integers.

12. Solve the following nonlinear programming problem using Lagrangian multipliers method.

Minimize $Z = 4x_1^2 + 2x_2^2 + x_3^2 = 4x_1x_2$

Subject to :

$x_1 + x_2 + x_3 = 15$

$2x_1 - x_2 + 2x_3 = 20$

x_1, x_2 and $x_3 \geq 0$

13. Maximize Z = $50x_1 + 15x_2 - 6x_1x_2 - 0.5x_1^2 - 10x_2^2$

Subject to

$4x_1 + x_2 \leq 50$

$x_1 + x_2 \leq 40$

$x_1, x_2 \geq 0$

14. An organization is planning to diversify its business with a maximum outlay of Rs. 4 crores. It has identified three different locations to install plants. The organization can invest in one or more of these plants subject to the availability of the fund. The different possible alternatives and their investments (in crores of rupees) and present worth of returns during the useful life (in crores of rupees) of each of these plants are summarized in the following table. The first row of the table has zero cost and zero return for all the plants. Hence, it is known as do-nothing alternative. Find the optimal allocation of the capital to different plants which will maximize the corresponding sum of the present worth of returns.

Alternative	Plant 1		Plant 2		Plant 3	
	Cost	Return	Cost	Return	Cost	Return
1	0	0	0	0	0	0
2	1	12	2	16	2	9
3	2	15	3	20	3	12
4	3	19	4	25	–	–

15. Consider the details of a distance networks as shown below.

Arc	Distance	Arc	Distance
1-2	6	5-6	13
1-3	7	5-8	9
1-4	10	6-7	5
2-3	8	6-8	4
2-5	4	6-9	8
3-4	6	6-10	3
3-5	11	7-9	10
3-6	3	8-10	10
3-7	5	9-10	9
4-7	7		

(a) Construct the distance network.

(b) Find the minimum spanning tree using PRIM algorithm.

16. The arrival rate of breakdown machines at a maintenance shop follows Poisson distribution with a mean of 6 per hour. The service rate of machines by a maintenance mechanic also follows Poisson distribution with a mean of 4 per hour. The downtime cost per hour of a breakdown machine is Rs. 300. The labour hour rate is Rs. 60. Determine the optimal number of maintenance mechanics to be employed to repair the mechanics such that the total cost is minimized.

PART C — (1 × 20 = 20 marks)

(Compulsory)

17. Consider the data of a flow network as shown below.

(a) Draw the flow network.

(b) Determine the maximum flow from the node I to the node 6 and also the corresponding flow pattern using matrix method,

Arc i-j	Flow f_{ij}	f_{ji}	Arc i-j	Flow f_{ij}	f_{ji}
1-2	60	10	3-4	35	-
1-3	35	25	3-5	30	28
2-3	25	20	4-5	45	–
2-4	19	24	4-6	40	–
2-5	25	30	5-6	55	–