(6 pages)

MAY 2014 **P/ID 77815/PMSL5**

Time : Three hours Maximum : 100 marks

PART A — (5 × 6 = 30 marks)

Answer any FIVE questions.

All questions carry equal marks.

1. What is sensitive analysis in linear programming? List its type.

2. Give the linear programming model of transportation problem.

3. What is separable programming? Discuss its merits.

4. State Kuhn-Tucker conditions.

5. List and explain the terminologies of dynamic programming.

6. What is production scheduling? Explain its types.

7. What is Gomory's cut? Illustrate it with a graph and explain its use.

8. Discuss the applications of Markov process in decision problems.

PART B — (5 × 10 = 50 marks)

Answer any FIVE questions.

All questions carry equal marks.

9. Solve the following LP problem using simplex method.

Maximize $Z = 20X_1 + 80X_2$

Subject to $4X_1 + 6X_2 \leq 90$

$8X_1 + 6X_2 \leq 100$

$X_1, X_2 \geq 0$

If the following new constraint is added to this model, find the solution to the new problem.

$5X_1 + 4X_2 \leq 80$

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 day	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 nonlinear programming problem using Lagrangian multipliers method.

Minimize $Z = 4X_1^2 + 2X_2^2 + X_3^2 - 4X_1X_2$

Subject to $X_1 + X_2 + X_3 = 15$

$2X_1 - X_2 + 2X_3 = 20$

$X_1, X_2 \text{ and } X_3 \geq 0$

12. 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	-	-

13. In a harbour, ships arrive with a mean rate of 24 per week. The harbour has 3 docks to handle unloading and loading of ships. The service rate of individual dock is 12 per week. The arrival rate and the service rate follow Poisson distribution. At any point of time, the maximum number of ships permitted in the harbour is 8. Find P_0, L_q, L_s, W_q and W_s.

14. Consider the details of a distance network as shown below.

Distance	Arc
1-2	8
1-3	5
1-4	7
1-5	16
2-3	15
2-6	3

Distance	Arc
2-7	4
3-4	5
3-6	6
4-5	8
4-6	12
5-8	7
6-8	9
6-9	15
7-9	12
8-9	6

(a) Construct the distance network

(b) Find the shortest path from node 1 to node 9.

15. Form a separable programming model for the following nonlinear programming problem.

Maximize $Z = 4X_1^2 + 2X_2$

Subject to $3X_1^2 + 4X_2 \leq 24$

$X_1 + X_2 \geq 0$

16. 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.

PART C — (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 1 to the node 6 and also the corresponding flow pattern using matrix method.

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