(7 pages)

MAY 2015 **P/ID 77815/PMSL5**

Time : Three hours Maximum : 100 marks

SECTION A — (5 × 6 = 30 marks)

Answer any FIVE questions.

1. Illustrate the concept of alternate optima in linear programming with a suitable graph.

2. A company manufactures three different products *(P_1, P_2* and *P_3)*. The details on resource requirement/unit, resources availability and profit/unit of each of these products are summarized in the following table.

Resource	Product			Resource availability per month
	P_1	P_2	P_3	
Man hours	2,000	1,500	1,000	38,000
Machine hours	1,000	1,500	2,000	33,000
Profit/unit (Rs.)	75,000	1,00,000	80,000	

Develop an integer programming model to determine the production volume of each of the products such that the total profit is maximized.

3. Write the mathematical model of the transportation problem.

4. Find the initial basic feasible solution to the following transportation problem using Vogel's approximation method

Origin		Destination					Supply
		A1	B1	C1	D1	E1	
	A	2	11	10	3	7	4
	B	1	4	7	2	1	8
	C	3	9	4	8	12	9
Demand		3	3	4	5	6	

5. How will you prepare the initial table for quadratic programming? Illustrate it with an example.

6. Discuss the applications of dynamic programming in industries.

7. What is fathomed node? Illustrate it pictorially with all necessary conditions.

8. Illustrate the application of Markov process to the brand switching problem in which the probability of transition (Switching) of customer from one brand to another will be given.

SECTION B — (5 × 10 = 50 marks)

Answer any FIVE questions.

9. Solve the following LP problem using revised simplex method.

Maximize $Z = 3X_1 + 2X_2 + 5X_3$

Subject to

$$X_1 + X_2 + X_3 \leq 9$$
$$2X_1 + 3X_2 + 5X_3 \leq 30$$
$$2X_1 - X_2 - X_3 \leq 8$$
$$X_1, X_2 \text{ and } X_3 \geq 0.$$

10. Solve the following assignment problem which is shown below using branch and bound algorithm. The cell entries represent the processing time in hours (C_{ij}) of the job i if it is assigned to the operator j

		Operator j			
		1	2	3	4
Job i	1	13	5	8	10
	2	9	15	18	10
	3	12	14	10	10
	4	10	14	9	12

11. For the following problem, using separable programming, formulate a linear programming model.

Maximize $Z = 5X_1^2 + 3X_2$

Subject to

$4X_1^2 + 2X_2 \leq 48$

$X_1, X_2 \geq 0.$

12. A distance network consists of eleven nodes which are distributed as shown in the following table. Find the shortest path from node 1 to node 11 and the corresponding distance using dynamic programming method.

Arc	Distance	Arc	Distance
1–2	8	5–8	12
1–3	7	5–9	7
1–4	1	6–9	9
2–5	5	7–9	6
3–5	9	7–10	13
3–6	2	8–11	4
3–7	8	9–11	2
4–7	10	10–11	15

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. Solve the following inter programming problem optimally.

Maximize $Z = 5X_1 + 4X_2$

Subject to

$$2X_1 + 4X_2 \le 25$$
$$2X_1 + 3X_2 \le 14$$
$$X_1, X_2 \ge 0 \text{ and}$$
$$X_1, X_2 \text{ are integers.}$$

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

Minimize $Z = 4X_1^2 - 0.02\,X_1^2 + X_2 - 0.02\,X_2^2$

Subject to

$$X_1 + 2X_2 = 120$$
$$X_1, X_2 \text{ and } X_3 \ge 0.$$

16. A company has factories at four different places (1, 2, 3 and 4) which supply items to warehouses A, B, C, D and E. Monthly factory capacities are 200, 175, 150 and 325, respectively. Monthly warehouse requirements are 110, 90, 120, 230 and 160, respectively. Unit shipping costs (in rupees) are given in the following table. Shipments from 1 to B and from 4 to D are not possible. Determine the optimum distribution plan to minimize the shipping cost.

From		To					Capacity
		A	B	C	D	E	
	1	13	–	31	8	20	200
	2	14	9	17	26	10	175
	3	25	11	12	17	15	150
	4	10	21	13	–	17	325
Requirement		110	90	120	230	160	

SECTION C — (1 × 20 = 20 marks)

Compulsory.

17. Consider the details of piping network which is used to transfer oil.

(a) Draw the flow network

(b) Find the maximum flow from node 1 to node 6

	Flow			Flow	
Arc i–j	f_{ij}	f_{ji}	Arc i–j	f_{ij}	f_{ji}
1-2	20	–	3-4	13	–
1-3	25	–	3-5	10	8
2-3	5	10	4-5	15	–
2-4	9	4	4-6	30	–
2-5	15	–	5-6	25	–