

(6 pages)

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**P/ID 37508/PBAH**

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Time : Three hours

Maximum : 80 marks

PART A — (5 × 5 = 25 marks)

Answer any FIVE questions.

All questions carry equal marks.

1. Distinguish between unbounded solution and alternate optima in linear programming using suitable graphs.
2. Give the 0-1 programming model of the assignment problem.
3. Distinguish between CPM and PERT.
4. The arrival rate of customers at a banking counter follows Poisson distribution with a mean of 30 per hour. The service rate of the counter clerk also follows Poisson distribution with a mean of 45 per hour.
  - (a) What is the probability of having 0 customer in the system ( $p_0$ )?
  - (b) What is the probability of having 8 customers in the system ( $p_8$ )?

5. What is time-chart/Gantt-chart in CPM? Illustrate it with an example.
6. Distinguish between breakdown maintenance and preventive maintenance.
7. List and explain the terminologies of game theory.
8. Discuss the cost-trade-off in inventory control.

PART B — (4 × 10 = 40 marks)

Answer any FOUR questions.

All questions carry equal marks.

9. A firm manufactures three products A, B and C. their profits per unit are Rs. 300, Rs. 200 and Rs. 400, respectively. The firm has two machines and the required processing time in minutes on each machine for each product is given in the following table

|         |   | Product |   |   |
|---------|---|---------|---|---|
|         |   | A       | B | C |
|         | 1 | 4       | 3 | 5 |
| Machine | 2 | 2       | 2 | 4 |

Machines 1 and 2 have 2000 and 2500 machine-minute, respectively. The upper limit for the production volumes of the product A, B and C are

100 units, 200 units and 50 units, respectively. But, the firm must produce a minimum of 50 units of the product A. Develop a LP model for this manufacturing situation to determine the production volume of each product such that the total profit is maximized.

10. Solve the following LP problem graphically

$$\text{Maximize } Z = 60X_1 + 90X_2$$

Subject to

$$X_1 + 2X_2 \leq 40$$

$$2X_1 + 3X_2 \leq 90$$

$$X_1 - X_2 \geq 10$$

$$X_1 \text{ and } X_2 \geq 0.$$

11. A company has received a contract to supply gravel for three new construction projects located in towns A, B and C. Construction engineers have estimated the required amounts of gravel which will be needed at these construction projects as shown below :

Project location Weekly requirement (truck loads)

|   |     |
|---|-----|
| A | 72  |
| B | 102 |
| C | 41  |

The company has three gravel plants X, Y and Z located in three different towns. The gravel required by the construction projects can be supplied by these three plants. The amount of gravel which can be supplied by each plant is as follows

| Plant | Amount available/week (truck loads) |
|-------|-------------------------------------|
| X     | 76                                  |
| Y     | 62                                  |
| Z     | 77                                  |

The company has computed the delivery cost from each plant to each project site. These costs (in rupees) are shown in the following table

|       |   | Cost per truck load |    |    |
|-------|---|---------------------|----|----|
|       |   | A                   | B  | C  |
|       | X | 4                   | 8  | 8  |
| Plant | Y | 16                  | 24 | 16 |
|       | Z | 8                   | 16 | 35 |

- (a) Schedule the shipment from each plant to each project in such a manner so as to minimize the total transportation cost within the constraints imposed by plant capacities and project requirements.
- (b) Find the minimum cost.

12. Vehicles are passing through a toll gate at the rate of 70 per hour. The average time to pass through the gate is 45 seconds. The arrival rate and service rate follow Poisson distribution. There is a complaint that the vehicles wait for long duration, The authorities are willing to install one more gate to reduce the average time to pass through the toll gate to 35 seconds if the idle time of the toll gate is less than 9% and the average queue length at the gate is more than 8 vehicles. Check whether the installation of the second gate is justified.
13. The activities involved in Alpha Garment Manufacturing Company are listed with their time estimates as in the following table. Draw the network for the given activities and carry out the critical path calculations.

| Activity | Description                 | Predecessor (s) | Duration (days) |
|----------|-----------------------------|-----------------|-----------------|
| A        | Forecast sales volume       | —               | 10              |
| B        | Study competitive market    | —               | 7               |
| C        | Design item and facilities  | A               | 5               |
| D        | Prepare production plan     | C               | 3               |
| E        | Estimate cost of production | D               | 2               |
| F        | Set sales price             | B, E            | 1               |
| G        | Prepare budget              | F               | 14              |

14. Consider the pay off matrix of Player A as given below and solve it optimally using graphical method.

|          |   |          |    |   |    |   |
|----------|---|----------|----|---|----|---|
|          |   | Player B |    |   |    |   |
|          |   | 1        | 2  | 3 | 4  | 5 |
|          | 1 | 4        | 2  | 5 | -6 | 6 |
| Player A | 2 | 7        | -9 | 7 | 4  | 8 |

PART C — (1 × 15 = 15 marks)

Compulsory.

15. An electronic equipment contains 500 resistors. When any resistor fails, it is replaced. The cost of replacing a resistor individually is Rs. 20,000. If all the resistors are replaced at the same time, the cost per resistor is Rs. 5,00. The percent surviving,  $S(i)$  at the end of month  $i$  is given in the following table.

|             |     |    |    |    |    |   |
|-------------|-----|----|----|----|----|---|
| Month $i$ : | 0   | 1  | 2  | 3  | 4  | 5 |
| $S(i)$ :    | 100 | 90 | 75 | 55 | 30 | 0 |

What is the optimum replacement plan?

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