



PART B — (5 × 13 = 65 marks)

11. (a) Solve the following Linear Programming problem : (13)

Maximize  $Z = 4x_1 + 3x_2 + 6x_3$

Subject to

$2x_1 + 3x_2 + 2x_3 \leq 440$

$4x_1 + 3x_3 \leq 470$

$2x_1 + 5x_2 \leq 430$

$x_1, x_2, x_3 \geq 0.$

Or

- (b) Write the dual of the following Linear Programming problem and solve by simplex method (13)

Maximize  $Z = 5x_1 + 12x_2 + 4x_3$

Subject to

$x_1 + 2x_2 + x_3 \leq 10$

$2x_1 - x_2 + x_3 = 8$

$x_1, x_2, x_3 \geq 0.$

12. (a) Five jobs are to be assigned to five workers in a job shop. The number of hours each worker would take to accomplish the jobs are shown in table 12(a). Determine the optimal assignment to minimize the time. (13)

| Workers | Job |    |    |    |    |
|---------|-----|----|----|----|----|
|         | 1   | 2  | 3  | 4  | 5  |
| 1       | 16  | 13 | 17 | 19 | 20 |
| 2       | 14  | 12 | 13 | 16 | 17 |
| 3       | 14  | 11 | 12 | 17 | 18 |
| 4       | 5   | 5  | 8  | 8  | 11 |
| 5       | 5   | 3  | 8  | 8  | 10 |

Table 12(a)

Or

- (b) Activities of a maintenance project are shown in Table 12(b). Draw the network, find the critical path and compute the floats? (13)

|            |     |     |     |     |     |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Activity : | 1-2 | 1-3 | 2-3 | 2-5 | 3-4 | 3-6 | 4-5 | 4-6 | 5-6 | 6-7 |
| Duration : | 15  | 15  | 3   | 5   | 8   | 12  | 1   | 14  | 3   | 14  |

Table 12(b)

13. (a) Annual demand for an item is 9000 units. Ordering cost is 100/order. Inventory carrying cost is Rs. 2.40 / unit / year. Unit price is Rs. 1/unit. Shortage cost is Rs. 5 / unit / year. Find optimum order quantity, optimum shortages, maximum inventory and total cost. Would you recommend back ordering considering the total cost when back ordering is not allowed? (13)

Or

- (b) Annual demand for an item is Rs. 12,000/per year. Ordering cost is Rs. 20/order. Holding cost is 16% of the price / unit / year. Price breaks are given below. (13)
- (i) Find EOQ,  
(ii) Find EOQ if ordering cost is changed to Rs. 30/order.

| Order size   | Cost/unit (Rs.) |
|--------------|-----------------|
| <2000        | 3               |
| 2000 – 3999  | 2.9             |
| 4000 or more | 2.85            |

14. (a) Workers come to tool store room to receive tools for accomplishing a particular operation. The average time between two arrivals is 60 seconds and the arrivals are assumed to be in Poisson distribution. The average service time is 40 seconds. Determine
- (i) The average queue length  
(ii) Average length of non empty queue  
(iii) Mean waiting time of an arrival  
(iv) Assume the charge of a skilled worker is Rs. 4/hour and that of tool store room attendant is Rs. 0.75/hour. Determine whether to go in for an additional tool store room attendant which will minimize the combined cost of attendant's idle time and the cost of worker's waiting time. (13)

Or

- (b) A company trading in motor vehicle spares wishes to determine the level of stock it should carry for the items in its range. Demand is not certain and there is a lead time for stock replenishment. For one item X, the following information is obtained. (13)

|                      |     |     |     |     |     |
|----------------------|-----|-----|-----|-----|-----|
| Demand (units/day) : | 3   | 4   | 5   | 6   | 7   |
| Probability :        | 0.1 | 0.2 | 0.3 | 0.3 | 0.1 |

Carrying cost per unit per day = 20 paise

Ordering cost per order = Rs. 5

Ideal time for replenishment = 3 days

Stock in hand at the beginning of simulation exercise was 20 units. You are required to carry out simulation run over a period of 10 days with the objective of evaluating the following inventory rule :

Order 15 units when present inventory plus any outstanding order falls below 15 units. The sequence of random nos used is 0, 9, 1, 1, 5, 1, 8, 6, 3, 5, 7, 1, 2, 9 using the first one for day one. Your calculation should include the total cost of operating this inventory rule for 10 days.

15. (a) A manufacturer is offered two machines A and B. A has cost price of Rs. 2,500. Its running cost is Rs. 400 for each of the first 5 years and increases by Rs. 100 every subsequent year. Machine 'B' having the same capacity as 'A' costs Rs. 1250 and has a running cost of Rs. 600 for 6 years, increasing by Rs. 100 per year thereafter. If money is worth 10% per year, which machine should be purchased? Scrap value of both the machines are assumed to be negligible. (13)

Or

- (b) Solve the game given in Table 15 (b) by graphical method. (13)

|                | Y <sub>1</sub> | Y <sub>2</sub> | Y <sub>3</sub> | Y <sub>4</sub> |
|----------------|----------------|----------------|----------------|----------------|
| X <sub>1</sub> | 19             | 6              | 7              | 5              |
| X <sub>2</sub> | 7              | 3              | 14             | 6              |
| X <sub>3</sub> | 12             | 8              | 18             | 4              |
| X <sub>4</sub> | 8              | 7              | 13             | -1             |

Table 15 (b)

PART C — (1 × 15 = 15 marks)

16. (a) A maintenance engineer estimates the number of the service technicians needed over the next five weeks to be 5, 7, 8, 4, 6 respectively. Excess number of service technician will cost Rs. 300/technician/week. Hiring the service technician in any week will incur a fixed cost of Rs. 400/- and an additional Rs. 200 per technician per week. Find the optimal service technician to be maintained. (15)

Or

- (b) A company manufacturing air-coolers has two plants located at Mumbai and Kolkata with a capacity of 200 units and 100 units per week respectively. The company supplies the air-coolers to its four show rooms situated at Ranchi, Delhi, Lucknow and Kanpur which have a maximum demand of 75, 100, 100 and 30 units respectively. Due to the difference in raw material cost and transportation cost, the profit per unit in rupees differs which is shown in the table below.

|          |  | Table  |       |         |        |
|----------|--|--------|-------|---------|--------|
|          |  | Ranchi | Delhi | Lucknow | Kanpur |
| Mumbai   |  | 90     | 90    | 100     | 110    |
| Kolkatta |  | 50     | 70    | 130     | 85     |

Plan the production programme so as to maximize the profit. The company may have its production capacity at both plants partly or wholly unused.