



- (b) A firm makes two products X and Y and has a total production capacity of 9 tonnes per day, X and Y requiring the same production capacity. The firm has a permanent contract to supply at least 2 tonnes of X and at least 3 tonnes of Y per day to another company. Each tonne of X requires 20 machine hours of production time and each tonne of Y requires 50 machine hours of production time. The daily maximum possible number of machine hours is 360. All the firm's output can be sold and the profit made is Rs. 80 per tonne of X and Rs. 120 per tonne of Y. **10**

Using graphical method of Linear Programming, determine the production schedule for maximum profit and also calculate this profit.

- 2 (a) State and explain either the North-West Corner Rule or Vogel's Approximation Method to solve a transportation problem of Operations Research. **8**
- (b) In the following matrix,  $O_1$ ,  $O_2$  and  $O_3$  are the origins,  $D_1$ ,  $D_2$ ,  $D_3$  and  $D_4$  are the destinations and the figures in the different cells of the matrix are the unit transportation cost, in rupees, from origin to destination. **12**

Origin	Destination				Supply
	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	
O <sub>1</sub>	6	4	1	5	14
O <sub>2</sub>	8	9	2	7	16
O <sub>3</sub>	4	3	6	4	5
Required	6	10	15	4	35

Solve the above transportation problem by any suitable technique and give your conclusions as clearly as possible.

**OR**

- 2** (a) What are the business applications of the Queueing Theory? Give the main characteristic features of the M/M/1 Queueing Model. **8**
- (b) A Departmental Store has a single cashier. During the rush hours, the customers arrive at the rate of 20 customers per hour. The average number of customers that can be processed by the cashier is 24 per hour. Assuming that the conditions for the use of single-channel queueing model apply, you are required to find the following :
- (i) Probability that the customer is idle ; **4**

- (ii) average number of customers in the queueing system; and **4**
- (iii) average time a customer spends in the queueing system. **4**

- 3** (a) Bring out the characteristic features of an assignment problem. What are the managerial situations where such problems are encountered? **8**
- (b) Suggest the optimum assignment for four workers A, B C and D to the four different jobs I, II, III and IV on the basis of the data given in the following table. The different cells in the table also show the time taken by the different workers in completing the different jobs (in hours) : **4**

<i>Workers</i>	<i>Jobs</i>			
	I	II	III	IV
A	16	20	24	32
B	22	22	30	16
C	18	12	10	28
D	30	28	18	14

Also calculate the total time taken in completing the jobs by the workers

**OR**

- 3 (a) What are the objectives and assumptions of the Game Theory? Explain how the saddle point is determined which indicates the best strategy for both the players in a 'Two person Zero-sum Game. **8**
- (b) Find the optimum strategies for each of the players A and B and the value of the game in the following matrix. **12**

<i>Player A</i>	<i>Player B</i>		
	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>
A <sub>1</sub>	8	-3	7
A <sub>2</sub>	6	-4	5
A <sub>3</sub>	-2	2	-3

- 4 What are the important assumptions underlying the sequencing/scheduling models? Explain with the help of a simple example, how sequencing/scheduling of *n* jobs can be done through 2 machines. **20**

**OR**

- 4 (a) Outline the characteristic features of PERT and CPM on the techniques of Project Planning and Network Analysis.

- (b) A publisher is planning to produce the second edition of a popular text book. The activities involved and their estimated times are given in the following table :

<i>Activity (i-j)</i>	<i>Time Duration (in days)</i>		
	<i>Optimistic</i>	<i>Most Likely</i>	<i>Pessimistic</i>
1-2	2	4	6
1-3	6	6	6
1-4	6	12	24
2-3	2	5	8
2-5	12	14	28
3-4	15	24	45
3-6	3	6	9
4-6	9	15	27
5-6	4	10	16

- (i) Draw an Arrow Diagram and show the various publication activities involved. **6**
- (ii) Identify the critical path and show the expected length of the publication project. **6**

**5** Write notes on any **two** of the following : **10+10**

- (a) Important Techniques of Operation Research
  - (b) Importance of Linear Programming in Decision-Making
  - (c) Hungarian Method of Solving Assignment Problems
  - (d) Analysis of PERT/COST
  - (e) Unbalanced Transportation Problems.
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