Operations Research

P. Pages : 4

Time : Three Hours

TKN/KS/16/7484

Max. Marks : 80

0364

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Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Assume suitable data whenever necessary.
9. Illustrate your answers whenever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.
11. Random number table is permitted.
12. Use of normal distribution table is allowed.

1. a) What do you mean by operations research? Explain the phases of operations research study. **5**

b) Find the dual problem for the following. **8**

Minimise $z = 5x_1 - 6x_2 + 4x_3$

Subject to $\quad 3x_1 + 4x_2 + 6x_3 \geq 9$

$\qquad x_1 + 3x_2 + 2x_3 \geq 5$

$\qquad 7x_1 - 2x_2 - x_3 \leq 10$

$\qquad x_1 - 2x_2 + 4x_3 \geq 4$

$\qquad 2x_1 + 5x_2 - 3x_3 = 3$

$\qquad$ where $x_1, x_2, x_3 \geq 0$

OR

2. a) What is sensitivity analysis? Discuss its significance. **3**

b) Solve the following LPP. **10**

Maximise $z = 2x_1 + 4x_2$

Subject to $2x_1 + x_2 \leq 18$

$\qquad 3x_1 + 2x_2 \geq 30$

$\qquad x_1 + 2x_2 = 25$

$\qquad x_1, x_2 \geq 0$

3. A company has form factories to meet demand of form warehouses. The demand, supply **13** and transportation cost is given in table below. Assess the optimal transportation cost between factories and warehouses.

Factory	Warehouses				Supply Unit
	W_1	W_2	W_3	W_4	
F_1	25	55	40	60	60
F_2	35	30	50	40	140
F_3	36	45	26	66	150
F_4	35	30	41	50	50
Demand units	90	100	120	140	

OR

4. a) How a transshipment problem is different than transportation problem. **3**

b) A company with a surplus truck in each of the cities A, B, C, D, E and one deficit truck in **10** each of the cities 1, 2, 3, 4, 5, 6. The distance between the cities in kilometers is given in matrix below. Find the assignment of trucks from cities in surplus to cities in deficit to minimise the total distance covered.

	1	2	3	4	5	6
A	12	10	15	22	18	8
B	10	18	25	15	16	12
C	11	10	3	8	5	9
D	6	14	10	13	13	12
E	8	12	11	7	13	10

5. a) Reduce the following game by dominance property and solve it. **7**

Player B

		1	2	3	4	5
	I	1	3	2	7	4
Player A	II	3	4	1	5	6
	III	6	5	7	6	5
	IV	2	0	6	3	1

b) Two machines A and B process seven jobs in the order $A \rightarrow B$. The processing time in **7** house are given below. Determine a sequence of jobs to minimise total elapsed time.

Job	1	2	3	4	5	6	7
M/c A	3	12	15	6	10	11	9
M/c B	8	10	10	6	12	1	3

OR

6. a) What is selective inventory control? Give a detailed description of ABC analysis. **7**

   b) Obtain the optimal order quantity using the information. **7**
   Annual requirement – 1 million.
   Order processing cost – Rs.28.8/order
   Holding cost – 20% of unit cost

Order size	Unit Price
0 – 9999	Rs. 2.00
10,000 – 19999	Rs. 1.60
20,000 & above	Rs. 1.40

7. A project consist of 9 activities whose time estimates (in weeks) and other characteristics are given. **13**
   i) Construct the network and determine the critical path and its duration.

   ii) What is the probability of completion of project one week ahead of schedule.

   iii) If the project is to be completed by December 31 of a given year and the project engineer is 95% sure of meeting the deadline, when should he start the project work?

Activity	Preceding Activity	Time estimates (weeks)		
		Most optimistic	Most likely	Most Pessimistic
A	-	2	4	6
B	-	6	6	6
C	-	6	12	24
D	A	2	5	8
E	A	11	14	23
F	B, D	8	10	12
G	B, D	3	6	9
H	C, F	9	15	27
I	E	4	10	16

OR

8. The following table gives the activities in a construction project and other relevant data. **13**

Activity	Immediate Predecessors	Time (Days)		Direct Cost (Rs.)	
		Normal	Crash	Normal	Crash
A	-				
B	-				
C	-				
D	A				
E	C				
F	A				
G	D, B, E				

Indirect cost vary as

Days	15	14	13	12	11	10	9	8	7	6
Cost (Rs.)	600	500	400	250	175	100	75	50	35	25

Draw the network and determine the project duration which will return in minimum total project cost.

9. A company offered two machines, A & B. A has cost price of Rs.2500. Its running cost is **13** Rs.400 per year for first five years and subsequently increases by Rs.100 / year thereafter. Machine B cost Rs.1250 and has running cost of Rs.600 for 6 years, increasing by Rs.100/yr thereafter. If money is worth 10% per annum which machine should be purchased if salvage is negligible for both machines.

OR

10. Life of a bulb is normally distributed about a mean of 6 weeks & std. deviation of 1 week. **13** Cost of replacing individual bulb is Rs.6. If all the bulbs are replaced at fixed interval & replace individual bulb as they fail, it cost Rs.325 per bulb to replace in group. Find the optimal group replacement interval.

11. a) What is a queuing problem? What are the basic characteristics of a queuing system? **4**

b) At a tailoring shop customer arrival rate is 6 per hour and follows Poisson distribution. The **10** tailor serves 10 customer per hour with the service time exponentially distributed. Determine

    i) Utilisation parameter

    ii) Probability that queuing system is idle.

    iii) Expected number of customer in the shop.

    iv) Expected number of customer waiting for service.

    v) Expected time a customer would spend in the tailors shop.

    vi) Probability that a customer is in the shop for 15 minutes.

OR

12. A plant has a large number of machines. Machines breakdown randomly and breakdowns **14** are independent of each other on breakdown machine is taken out of production till its repair. The past data reveals the following distribution.

No. of breakdown per hour	Prob.	No of hrs Required for repair / breakdown	Prob.
0	0.9	1	0.1
1	0.085	2	0.24
2	0.012	3	0.45
3	0.003	4	0.165
		5	0.04
		6	0.005

The breakdown cost Rs. 80/hr due to production loss and repairs cost Rs.8/hr. How many repairmen should be hired by the company? Simulate the system for 20 hours using random numbers.

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