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Seventh Semester B.E. Degree Examination, Dec.2017/Jan.2018
Operation Research

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting
atleast TWO questions from each part.**

PART – A

- 1 a. Write the limitations of operation research models. (06 Marks)
- b. Old machines can be bought at Rs. 2 lakhs each and new machines at Rs. 5 lakhs each. The old machines produce 3 components/week, while new machines produce 5 components/week, each component being worth Rs. 30000. A machine (new – old) costs Rs. 1lakhs/week to maintain. The company has only Rs. 80 lakhs to spend on the machines. How many of each kind should the company buy to get a profit of more than Rs. 6 lakhs/week? Assume that the company cannot house more than 20 machines. Formulate the problem and solve it graphically. (14 Marks)
- 2 a. Solve the LPP maximize : $z = 5x_1 + 2x_2$
 Subject to $4x_1 + 2x_2 \leq 16$
 $3x_1 - x_2 \leq 9$
 $3x_1 + x_2 \leq 9$
 $x_1, x_2 \geq 0$. (10 Marks)
- b. Use two phase simplex method to minimize : $z = x_1 + x_2 + x_3$
 subject to the constraints $x_1 - 3x_2 + 4x_3 = 5$
 $x_1 - 2x_2 \leq 3$
 $2x_2 - x_3 \geq 4$
 $x_1 \geq 0, x_2 \geq 0, x_3$ is unrestricted. (10 Marks)
- 3 a. Use MODI method to check the optimality of the following transportation problem: (10 Marks)

	W ₁	W ₂	W ₃	W ₄	Capacity
F ₁	19 5	30	50	10 2	7
F ₂	70	30	40 7	60 2	9
F ₃	40	8 8	70	20 10	18
Requirement	5	8	7	14	

- b. Total cost = 779
- A product is produced by four factories A, B, C and D. The unit production costs in them are Rs.2.00, Rs. 3.00, Rs.1.00 and Rs. 5.00 respectively. Their production capacities are factory A = 50 units, B = 70 units, C = 30 units and D = 50 units. These factories supply the product to four stores, demands of which are 25, 35, 105 and 20 units respectively. Unit transport cost in rupees from each factory to each store is given in the table.

	Store			
	1	2	3	4
Factory A	2	4	6	11
B	10	8	7	5
C	13	3	9	12
D	4	6	8	3

Determine the extent of deliveries from each of the factories to each of the stores so that the total production and transportation cost is minimum. (10 Marks)

- 4 a. Compare transportation problem with assignment problem. (04 Marks)
- b. Solve the following salesman problem given by the following data :
 $C_{12} = 20, C_{13} = 4, C_{14} = 10, C_{23} = 5, C_{34} = 6, C_{25} = 10, C_{35} = 6, C_{45} = 20$ where $C_{ij} = C_{ji}$.
 There is no route between i and j , if the values for C_{ij} is not shown. (08 Marks)
- c. Four workers are available to work on four machines and the respective costs associated with each machine worker assignment is given below :

	Machine			
	M1	M2	M3	M4
W1	12	3	6	–
W2	4	10	–	5
W3	7	2	8	9
W4	–	7	8	6

The sign (–) indicates that the particular worker machine assignment is not permitted.

- i) Determine the optimum assignment
- ii) A fifth machine is available to replace one of the existing machines and the associated costs are : $W_1 = 4Rs, W_2 = 3Rs, W_3 = 3Rs$ and $W_4 = 2Rs$. determine whether the new machine can be accepted and if so, which machine does it replace. (08 Marks)

PART – B

- 5 a. Use the graphical method to obtain the sequencing of jobs and machines and find the total elapsed time, idle times of the jobs. (10 Marks)

Job 1	Sequence	A	B	C	D	E
	Time	3	4	2	6	2
Job 2	Sequence	B	C	A	D	E
	Time	5	4	3	2	6

- b. Find an optimal sequence for processing nine jobs through the machines A, B, C in the order A, B, C. processing times are given below in hours. Find the total elapsed time for the optimal sequence. (10 Marks)

Jobs	1	2	3	4	5	6	7	8	9
Machine A	4	9	5	10	6	12	8	3	8
Machine B	6	4	8	9	4	6	2	6	4
Machine C	10	12	9	11	14	15	10	14	12

- 6 a. Define the following :
- Pure strategy
 - Mixed strategy
 - The maximum – minimax principle
 - Saddle point.
- b. Solve the following :

		B			
		I	II	III	IV
A	I	19	6	7	5
	II	7	3	14	6
	III	12	8	18	4
	IV	8	7	13	–1

- c. In a game of matching coins, player A wins Rs. 8, if both coins show heads and Rs. 1 if both are tails. Player B wins Rs. 3 coins do not match. Given the choice of being player A or player. B which would you choose and what would be your strategy? (06 Marks)

- 7 a. Arrival rate of telephone calls at telephone booth are according to Poisson distribution with an average time of 9 min between the two consecutive arrivals. The length of telephone call is assumed to be exponentially distributed with mean 3 minutes.
- Determine the probability that a person arriving at the booth will have to wait
 - Find the average queue length that is formed from time to time
 - Telephone Company will install a second booth when convinced that an arrival would expect to have to wait at least 4 minutes for the phone. Find the increase in flow of arrivals which will justify a second booth
 - What is probability that an arrival will have to wait for more than 10 minutes before the phones is free
 - What is the probability that he will have to wait for more than 10 minutes before the phone is available and the call is also complete?
 - Find the fraction of the day that the phone will be in use. **(10 Marks)**
- b. A bank has 2 tellers working on savings accounts. The first teller handles withdrawals only. The second teller handles deposits only. It has been found that the service time distributions of both deposits and withdrawals are exponential with mean service time of 3 minutes per customer. Depositors and withdrawers are found to arrive in a Poisson fashion throughout the day with mean arrival rate of 16 and 14 per hour. What would be the effect on the average waiting time for depositors and withdrawers if each teller could handle both withdrawals and deposits? What would be the effect if this could only be accomplished by increasing the service time to 3.5 minutes? **(10 Marks)**
- 8 a. Define the following :
- dummy activity
 - burst event
 - optimistic time
 - cost slope. **(08 Marks)**
- b. Determine the optimum project duration (days) and cost for following data :

Activities	Normal		Crash	
	Time	Cost	Time	Cost
1 – 2	8	100	6	200
1 – 3	4	150	2	350
2 – 4	2	50	1	90
2 – 5	10	100	5	400
3 – 4	5	100	1	200
4 – 5	3	80	1	100

Indirect cost if Rs. 70/day.

(12 Marks)

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