Code : 021723

B.Tech 7th Semester Exam., 2020

OPERATIONS RESEARCH

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct answer/Fill in the blanks (any *seven*) of the following : 2×7=14

(a) A constraint in an LP model restricts

(i) value of objective function

(ii) value of a decision variable

(iii) use of the available resource

(iv) All of the above

(b) A constraint in an LP model becomes redundant because

(i) two iso-profit lines may be parallel to each other

(ii) the solution is unbounded

(iii) this constraint is not satisfied by the solution values

(iv) None of the above

(c) Which of the following methods is used to verify the optimality of the current solution of the transportation problem?

(i) Least cost method

(ii) Vogel's approximation method

(iii) Modified distribution method

(iv) All of the above

(d) The random numbers generated by a computer software are uniformly distributed fractions between ____ and ____.

(e) Customer behaviour in which the customer moves from one queue to another in a multiple channel situation is

(i) balking

(ii) reneging

(iii) jockeying

(iv) alternating

(f) Generally, the PERT technique deals with the project of

(i) repetitive nature

(ii) non-repetitive nature

(iii) deterministic nature

(iv) None of the above

(g) A state in a dynamic programming problem represents

(i) various conditions of the decision process at a stage

(ii) the status of the system at a particular stage

(iii) possible effects that the current decision has on future courses of action

(iv) All of the above

(h) In (M/M/1) : (∞/FIFO) model, $1/(\mu - \lambda)$ represents

(i) L_s, length of the system

(ii) L_q, length of the queue

(iii) W_q, waiting time in queue

(iv) W_s, waiting time in system

(i) If small orders are placed frequently (rather than placing large orders infrequently), then total inventory cost

(i) increases

(ii) reduces

(iii) either increases or reduces

(iv) is minimized

(j) When the sum of gains of one player is equal to the sum of losses to another player in a game, this situation is known as

(i) biased game

(ii) zero-sum game

(iii) fair game

(iv) All of the above

2. Solve the given linear programming problem : 14

Maximize $Z = 6x_1 + 10x_2 + 2x_3$

subject to

$$2x_1 + 4x_2 + 3x_3 \leq 40$$
$$x_1 + x_2 \leq 10$$
$$2x_2 + x_3 \leq 12$$

and $x_1, x_2, x_3 \geq 0$.

3. Given $x_{13} = 50$ units, $x_{14} = 20$ units, $x_{21} = 55$ units, $x_{31} = 30$ units, $x_{32} = 35$ units, and $x_{34} = 25$ units. Is it an optimal solution to the transportation problem?

				Available units
6	1	9	3	70
11	5	2	8	55
10	12	4	7	90
Required units 85	35	50	45	

If not, modify it to obtain a better feasible solution. 14

4. *(a)* Explain what factors must be considered when designing a simulation experiment. 4

(b) A firm has single-channel service station with the following arrival and service time probability distributions :

Arrivals (min)	*Probability*	*Service Time* (min)	*Probability*
1·0	0·35	1·0	0·20
2·0	0·25	1·50	0·35
3·0	0·20	2·0	0·25
4·0	0·12	2·5	0·15
5·0	0·08	3·0	0·05

The customer's arrival at the service station is a random phenomenon and the time between the arrival varies from one minute to five minutes. The service time varies from one minute to three minutes. The queuing process begins at 10·00 a.m. and proceeds for nearly 2 hours. An arrival goes to the service facility immediately, if it is free, otherwise it waits in a queue. The queue discipline is first-come first-served. If the attendant's wages are ₹8 per hour and the customer's waiting time costs ₹9 per hour, then would it be an economical proposition to engage a second attendant? Answer on the basis of Monte Carlo simulation technique. 10

5. *(a)* State and prove the Markovian property of interarrival times. 5

(b) A road transport company has one reservation clerk on duty at a time. He handles information of bus schedules and makes reservations. Customers arrive at a rate of 8 per hour and the clerk can, on an average, service 12 customers per hour. After stating your assumptions, answer the following :

(i) What is the average number of customers waiting for the service of the clerk?

(ii) What is the average time a customer has to wait before being served?

(iii) The management is contemplating to install a computer system for handling information and reservations. This is expected to reduce the service time from 5 to 3 minutes. The additional cost of having the new system works out to ₹ 50 per day. If the cost of goodwill of having to wait is estimated to be 12 paise, per minute spent waiting, before being served, should the company install the computer system? Assume 8 hours working day. 9

6. (a) An assembly is to be made from two parts *X* and *Y*. Both parts must be turned on a lathe. *Y* must be polished whereas *X* needs not be polished. The sequence of activities, together with their predecessors, is given below :

Activity	*Description*	*Predecessor Activity*
A	Open work order	—
B	Get material for *X*	*A*
C	Get material for *Y*	*A*
D	Turn *X* on lathe	*B*
E	Turn *Y* on lathe	*B, C*
F	Polish *Y*	*E*
G	Assemble *X* and *Y*	*D, F*
H	Pack	*G*

Draw a network diagram of activities for the project. 7

(b) Compare and contrast CPM and PERT. Under what conditions would you recommend the scheduling by PERT? Justify your answer with reasons. 7

7. *(a)* There are seven jobs, each of which has to go through the machines A and B in the order AB. Processing times in hours are as follows :

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

Determine a sequence of these jobs that will minimize the total elapsed time T. Also find T and idle time for machines A and B. 7

(b) Use dynamic programming to solve the following problem : 7

Minimize $Z = x_1^2 + x_2^2 + x_3^2$

subject to the constraints

$$x_1 + x_2 + x_3 \geq 15$$
$$x_1, x_2, x_3 \geq 0$$

8. *(a)* A firm is considering the replacement of a machine, whose cost price is ₹ 12,200 and its scrap value is ₹ 200. From experience the running

(Turn Over)

(maintenance and operating) costs are found to be as follows :

Year	:	1	2	3	4	5	6	7	8
Running cost (₹)	:	200	500	800	1,200	1,800	2,500	3,200	4,000

When should the machine be replaced? 7

(b) A shop is about to order some heaters for a forecast spell of cold weather. The shop pays ₹ 1,000 for each heater, and during the cold spell they sell for ₹ 2,000 each. The demand for the heater declines after the cold spell is over, and any unsold units are sold at ₹ 500. Previous experience suggests the likely demand for heaters is as follows :

Demand	:	10	20	30	40	50
Probability	:	0·20	0·30	0·30	0·10	0·10

How many heaters should the shop buy? 7

9. *(a)* Solve the game whose payoff matrix is given below : 7

		Player B			
Player A	B_1	B_2	B_3	B_4
A_1	3	2	4	0
A_2	3	4	2	4
A_3	4	2	4	0
A_4	0	4	0	8

(b) Find the solution of the following non-linear programming problem by using Kuhn-Tucker conditions : 7

Maximize

$$Z = 10x_1 - x_1^2 + 10x_2 - x_2^2$$

subject to the constraints

$$x_1 + x_2 \leq 9$$
$$x_1 - x_2 \geq 6$$
$$x_1, x_2 \geq 0$$

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