

C. U. SHAH UNIVERSITY

Winter Examination-2021

Subject Name: Operation Research

Subject Code: 4TE07ORE1

Branch: B.Tech (Mechanical)

Semester: 7

Date: 20/12/2021

Time: 02:30 To 05:30

Marks: 70

Instructions:

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
- (2) Instructions written on main answer book are strictly to be obeyed.
- (3) Draw neat diagrams and figures (if necessary) at right places.
- (4) Assume suitable data if needed.

Q-1

Attempt the following questions:

(14)

- (a) The Scientific method in O.R. study generally involves
 - a) Judgment phase
 - b) Research phase
 - c) Action phase
 - d) All of these
- (b) Graphical method can be applied to solve a LPP when there are only _____ variable.
 - (a) One
 - (b) More than One
 - (c) Two
 - (d) Three
- (c) For maximization LPP, the simplex method is terminated when all values
 - (a) $c_j - z_j \leq 0$
 - (b) $c_j - z_j = 0$
 - (c) $c_j - z_j \geq 0$
 - (d) $z_j \leq 0$
- (d) The solution to a transportation problem with m-rows and n-columns is feasible if number of positive allocations are
 - (a) $m + n$
 - (b) $m \times n$
 - (c) $m + n - 1$
 - (d) all of these
- (e) In transportation problem if total supply > total demand we add _____.
 - (a) dummy row with cost 0
 - (b) dummy column with cost 0
 - (c) dummy row with cost 1
 - (d) dummy column with cost 1
- (f) In Assignment Problem the value of decision variable x_{ij} is _____.
 - (a) no restriction
 - (b) two or one
 - (c) one or zero
 - (d) none of them
- (g) If number of sources is not equal to number of destination in Assignment problem then it is called _____.
 - (a) unbalanced
 - (b) symmetric
 - (c) unsymmetric
 - (d) balanced
- (h) What is concerned with the prediction of replacement costs and determination of the most economic replacement policy?
 - (a) search theory
 - (b) theory of replacement
 - (c) probabilistic programming
 - (d) none of these
- (i) Which of the following replacement policies is considered to be dynamic in nature?
 - (a) Time is a continuous variable and the money value does not change with time
 - (b) When money value does not change with time and time is a discrete variable
 - (c) When money value changes with time
 - (d) When money value remains constant for some time and then goes on changing with time
- (j) Priority queue discipline may be classified as
 - (a) finite or infinite
 - (b) limited and unlimited



- (c) pre-emptive or non-pre-emptive (d) all of the above
- (k) Which of the following is not a key operating characteristic for a queuing system
 (a) utilization factor
 (b) percent idle time
 (c) average time spent waiting in the system and queue
 (d) none of the above
- (l) Which of the cost estimates and performance measures are not used for economic analysis of a queuing system
 (a) cost per server per unit of time
 (b) cost per unit of time for a customer waiting in the system
 (c) the average number of customers in the system
 (d) average waiting time of customers in the system
- (m) The objective of network analysis is to _____.
 (a) minimize total project duration
 (b) minimize total project cost
 (c) minimize production delays, interruption and conflicts
 (d) maximize total project duration
- (n) The activity cost corresponding to the crash time is called the _____.
 (a) critical time (b) normal time (c) cost slope (d) crash cost

Attempt any four questions from Q-2 to Q-8.

Q-2

Attempt all questions

- (a) Explain the phases of OR. Also state the limitation of OR. (06)
- (b) Solve the following LPP by Big-M method. (08)
- Minimize cost, $Z = 3x_1 + 8x_2$
 Subject to, $x_1 + x_2 = 200$
 $x_1 \leq 80$
 $x_2 \geq 60$
 $x_1, x_2 \geq 0$.

Q-3

Attempt all questions

- (a) Solve the following linear programming problem by simplex method: (08)
- Maximize $Z = 800x_1 + 600x_2 + 300x_3$
 Subjected to the constraints
- $$10x_1 + 4x_2 + 5x_3 \leq 2000$$
- $$2x_1 + 5x_2 + 4x_3 \leq 1009$$
- $$x_1, x_2, x_3 \geq 0$$
- (b) Write the dual of the following linear programming problem: (06)
- Minimize $Z = 5x_1 - 6x_2 + 4x_3$
 Subjected to the constraints
- $$3x_1 + 4x_2 + 6x_3 \geq 9$$
- $$x_1 + 3x_2 + 2x_3 \geq 5$$
- $$7x_1 - 2x_2 - x_3 \leq 10$$
- $$x_1 - 2x_2 + 4x_3 \geq 4$$
- $$2x_1 + 5x_2 - 3x_3 \geq 3$$
- $$x_1, x_2, x_3 \geq 0$$

Q-4

Attempt all questions

- (a) Find the initial basic feasible solution of the following transportation problem by (04)



Vogel's Approximation Method.

	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>	<i>Capacity</i>
<i>F1</i>	19	30	50	10	7
<i>F2</i>	70	30	40	60	9
<i>F3</i>	40	8	70	20	18
<i>Requirement</i>	5	8	7	14	

- (b) The captain of a cricket team has to allot five middle order batting positions to six batsmen available for selection. The average runs scored by each batsmen at these positions are summarized in a table below: (10)

<i>Batsman</i>	<i>Batting Position</i>				
	<i>III</i>	<i>IV</i>	<i>V</i>	<i>VI</i>	<i>VII</i>
<i>A</i>	40	40	35	25	50
<i>B</i>	42	30	16	25	27
<i>C</i>	50	48	40	60	50
<i>D</i>	20	19	20	18	25
<i>E</i>	58	60	59	55	53
<i>F</i>	45	52	38	50	49

Using Assignment model, determine the assignment of batsmen to positions which would give maximum runs in favour of team. Which batsmen will not qualify for selection based on the solution obtained?

Q-5

Attempt all questions

- (a) In the modification of a plant layout of a factory four new machines M_1 , M_2 , M_3 and M_4 are to be installed in a machine shop. There are five vacant places A , B , C , D and E available. Because of limited space, machine M_2 cannot be placed at C and M_3 cannot be placed at A . the cost of locating of machine I to place j in rupees is shown below. Find optimal assignment schedule. (04)

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
M_1	9	11	15	10	11
M_2	12	9	-	10	9
M_3	-	11	14	11	7
M_4	14	8	12	7	8

- (b) A manufacturing company has 3 plants X , Y and Z Which supply to the distributors located at A , B , C , D and E . Monthly plant capacities are 80, 50 and 90 units respectively. Monthly requirements of distributors are 40, 40, 50, 40 and 80 units respectively. Unit transportation costs are given below in rupees: (10)

<i>From</i>	<i>To</i>				
	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>
X	5	8	6	6	3
Y	4	7	7	6	6
Z	8	4	6	6	3

Determine an optimal distribution for the company in order to minimize the total transportation cost.

Q-6

Attempt all questions

- (a) The purchase price of a machine is Rs. 52000. The installation charges amount to Rs. 14400 and its scrap value is only Rs. 6400. The maintenance cost in various years is (06)



given below:

<i>Year</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>
<i>Maintenance Cost</i>	<i>1000</i>	<i>3000</i>	<i>4000</i>	<i>6000</i>	<i>8000</i>	<i>11600</i>	<i>16000</i>	<i>19200</i>

After how many years should the machine be replaced? Assume that the machine replacement can be done only at the year ends.

- (b) A project schedule has the following characteristics: (i) Construct the network. (ii) Compute E and L for each event, and (iii) Find the critical path. (08)

<i>Activity</i>	<i>Time (weeks)</i>	<i>Activity</i>	<i>Time (weeks)</i>
<i>1-2</i>	<i>4</i>	<i>5-6</i>	<i>4</i>
<i>1-3</i>	<i>1</i>	<i>5-7</i>	<i>8</i>
<i>2-4</i>	<i>1</i>	<i>6-8</i>	<i>1</i>
<i>3-4</i>	<i>1</i>	<i>7-8</i>	<i>2</i>
<i>3-5</i>	<i>6</i>	<i>8-10</i>	<i>5</i>
<i>4-9</i>	<i>5</i>	<i>9-10</i>	<i>7</i>

Q-7

Attempt all questions

- (a) Write a short note on “ABC analysis” of inventory control technique. (07)
- (b) Customers arrive at a one window drive-in bank according to Poisson distribution with mean 10 per hour. Service time per customer is exponential with mean 5 minutes. The space in front of the window including that for the serviced car can accommodate a maximum of 3 cars. Others can wait outside this space. (i) What is the probability that an arriving customer can drive directly to the space in front of the window? (ii) What is the probability that an arriving customer will have to wait outside the indicated space? (iii) How long is an arriving customer expected to wait before starting service? (07)

Q-8

Attempt all questions

- (a) The time estimates (in weeks) for the activities of a PERT network are given below: (07)

<i>Activity</i>	<i>t₀</i>	<i>t_m</i>	<i>t_p</i>
<i>1-2</i>	<i>1</i>	<i>1</i>	<i>7</i>
<i>1-3</i>	<i>1</i>	<i>4</i>	<i>7</i>
<i>1-4</i>	<i>2</i>	<i>2</i>	<i>8</i>
<i>2-5</i>	<i>1</i>	<i>1</i>	<i>1</i>
<i>3-5</i>	<i>2</i>	<i>5</i>	<i>14</i>
<i>4-6</i>	<i>2</i>	<i>5</i>	<i>8</i>
<i>5-6</i>	<i>3</i>	<i>6</i>	<i>15</i>

- (i) Draw the project network and identify all the paths through it. (ii) Determine the expected project length. (iii) Calculate the standard deviation and variance of the project length.
- (b) The following mortality rates have been observed for certain type of light bulbs: (07)

<i>End of month</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
<i>Percentage failing</i>	<i>10</i>	<i>20</i>	<i>50</i>	<i>70</i>	<i>100</i>

There are 1000 bulbs in use and it costs Rs. 10 to replace an individual bulb which has burnt out. If all the bulbs are replaced simultaneously, it would cost Rs. 5 per bulb. It is proposed to replace all the bulbs at fixed intervals whether they have fixed or not and to continue replacing fused bulbs as and when they fail. At what intervals should all the bulbs be replaced so that the proposal is economical?

