

**C. U. SHAH UNIVERSITY****Summer Examination-2022****Subject Name: Operation Research****Subject Code: 4TE07ORE1****Branch: B.Tech (Mechanical)****Semester: 7****Date: 27/04/2022****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) An operation research model is good as
- (a) It provides some logical and systematic approach to the problem.
  - (b) It incorporates useful tools which help in eliminating duplication of methods applied to solve specific problem.
  - (c) It helps in finding avenues for new research and improvements in a system.
  - (d) All of the above
- (b) Optimal solution in an LPP is \_\_\_\_\_.
- (a) Which maximizes or minimizes the objective function
  - (b) Which maximizes the objective function
  - (c) Which minimizes the objective function
  - (d) Which satisfies the non negativity restrictions
- (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) 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
- (e) 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
- (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) The purpose of dummy row or column in an assignment problem is to
- (a) obtain balance between total activities and total resources
  - (b) prevent a solution from becoming degenerate
  - (c) provide a means of representing a dummy problem
  - (d) any one of the above.
- (h) When money value changes with time at 10 %, then PWF for the first year is
- (a) 1
  - (b) 0.909
  - (c) 0.852
  - (d) 0.9
- (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) 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
- (k) Service mechanism in a queuing system is characterized by
- (a) server's behaviour (b) customer's behavior  
 (c) customers in the system (d) all of the above
- (l) The minimum stock level is calculated as
- (a) Reorder level – (Normal consumption x Normal delivery time)  
 (b) Reorder level + (Normal consumption x Normal delivery time)  
 (c) (Reorder level + Normal consumption) x Normal delivery time  
 (d) (Reorder level + Normal consumption) / Normal delivery time
- (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 difference between total and free float is \_\_\_\_\_.
- (a) total (b) free (c) independent (d) interference

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

**Q-2**

**Attempt all questions**

- (a) Explain Methodology of OR. (07)
- (b) Solve the following LPP by Big-M method. (07)
- Maximize  $Z = 2x_1 + 4x_2 - 3x_3$   
 Subject to,  $x_1 + x_2 + x_3 \geq 8$   
 $x_1 - x_2 \geq 1$   
 $3x_1 + 4x_2 + x_3 \leq 40$   
 $x_1, x_2, x_3 \geq 0$

**Q-3**

**Attempt all questions**

- (a) Solve the following problem using simplex method: (07)
- Minimize  $Z = x_1 - 3x_2 + 2x_3$   
 Subject to  $3x_1 - x_2 + 2x_3 \leq 7$   
 $-2x_1 + 4x_2 + 2x_3 \leq 12$   
 $-4x_1 + 3x_2 + 8x_3 \leq 10$   
 $x_1, x_2, x_3 \geq 0$
- (b) Write the dual of the following Problem. (07)
- Minimize  $Z = 3x_1 - x_2 + x_3$   
 Subject to,  $4x_1 - x_2 \leq 8$   
 $8x_1 + x_2 + 3x_3 \geq 12$   
 $5x_1 - 6x_3 \leq 13$   
 $x_1, x_2, x_3 \geq 0$



**Q-4****Attempt all questions**

- (a) A leading firm has three auditors. Each auditor can work up to 160 hours during the next month, during which time three projects must be completed. Project 1 will take 130 hours, project 2 will take 120 hours, and project 3 will take 160 hours. The amount per hour that can be billed for assigning each auditor to each project is given in the following table: (07)

<i>Auditor</i>	<i>Project</i>		
	<i>1</i> <i>Rs.</i>	<i>2</i> <i>Rs.</i>	<i>3</i> <i>Rs.</i>
<i>1</i>	1200	1500	1900
<i>2</i>	1400	1300	1200
<i>3</i>	1600	1400	1500

Formulate this as a transportation problem and find the optimal solution.

- (b) A company has a team of four salesmen and there are four districts where the company wants to start its business. After taking in to account the capabilities of salesmen and the nature of districts, the company estimates that the profit per day in rupees for each salesman in each district is as given below: (07)

		<b>District</b>			
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Salesman</b>	<b>A</b>	16	10	14	11
	<b>B</b>	14	11	15	15
	<b>C</b>	15	15	13	12
	<b>D</b>	13	12	14	15

Find the assignment of salesmen to various districts which will yield maximum profit.

**Q-5****Attempt all questions**

- (a) Self-help canteen employs one cashier at its counter, 8 customers arrive every 10 minutes on an average. The cashier can serve at the rate of one customer per minute. Assume Poisson's distribution for arrival and exponential distribution for service patterns. Determine: (07)
- Average number of customers in the system,
  - Average queue length,
  - Average time a customer spends in the system
- (b) A bakery has to supply 500 cakes every Sunday to its retailers for sale throughout the week. The cost of preparing one cake is Rs. 20. The bakery procures the cakes from a bigger bakery and the cost involved in this are Rs. 200 per order. Inventory carrying cost is 20% of the cost of the cake. (07)
- Determine: (i) Economic lot size  
(ii) The total optimal cost.

**Q-6****Attempt all questions**

- (a) Five different machines can do any of the five jobs, with different profits resulting from each assignment as shown in the adjoining table. Find out maximum profit possible through optimal assignment. (07)



Job ↓	Machine				
	A	B	C	D	E
1	30	37	40	28	40
2	40	24	27	21	36
3	40	32	33	30	35
4	25	38	40	36	36
5	29	62	41	34	39

- (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: (07)

From	To				
	A	B	C	D	E
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-7

#### Attempt all questions

- (a) The following mortality rates have been observed for certain type of light bulbs: (07)

End of month	1	2	3	4	5
Percentage failing	10	20	50	70	100

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?

- (b) A project schedule has the following characteristics: (07)

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

(i) Construct the network. (ii) Compute E and L for each event, and (iii) Find the critical path.

### Q-8

#### Attempt all questions

- (a) Write a short note on “ABC analysis” of inventory control technique. (07)

- (b) The initial cost of a machine is Rs. 71000 and scrape value is Rs. 1000. The maintenance costs found from experience are as below. Find when machine should be replaced? (07)

Year(n)	1	2	3	4	5	6	7	8
Maintenance cost f(t)	2000	3500	5000	7000	10000	13000	17000	21000

