

**GUJARAT TECHNOLOGICAL UNIVERSITY****MCA - SEMESTER- IV EXAMINATION – SUMMER 2017****Subject Code:2640003****Date:03/06/2017****Subject Name: Operations Research****Time:10.30 AM TO 01.00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

**Q.1 (a)** What is Operations Research? Briefly explain the Applications of OR in various fields. **07**

**(b)** A plastic products manufacturer has 1,200 boxes of transparent wrap in stock at one factory and another 1,000 boxes at its second factory. The manufacturer has orders for this product from three different retailers, in quantities of 1,000, 700 and 500 boxes respectively. The unit shipping costs (in rupees per box) from the factories to retailers are as follows: **07**

| From        | To: | Retailer - I | Retailer - II | Retailer - III |
|-------------|-----|--------------|---------------|----------------|
| Factory – A |     | 14           | 13            | 11             |
| Factory - B |     | 13           | 13            | 12             |

The manufacturer needs to determine a minimum cost shipping schedule for satisfying all demands from current inventory. Formulate this problem as an LP Model. Do not solve it.

**Q.2 (a)** Solve the following LPP through Graphic Method: **07**

$$\text{Minimize } Z = 200x_1 + 400x_2$$

$$\text{Subject to } x_1 + x_2 \geq 200$$

$$x_1 + 3x_2 \geq 400$$

$$x_1 + 2x_2 \leq 350$$

$$x_1, x_2 \geq 0$$

**(b)** Solve the following LPPs through Simplex Method. **07**

$$\text{Maximize: } Z = 5x_1 + 2x_2$$

$$\text{Subject to } 4x_1 + 2x_2 \leq 16$$

$$3x_1 + x_2 \leq 9$$

$$3x_1 - x_2 \leq 9$$

$$x_1, x_2 \geq 0$$

**OR**

**(b)** Solve the following LPPs through Big-M Method. **07**

$$\text{Maximize: } Z = 2x_1 + 4x_2$$

$$\text{Subject to } 2x_1 + x_2 \leq 18$$

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

$$x_1 + 2x_2 = 26$$

$$x_1, x_2 \geq 0$$

- Q.3 (a)** The transportation costs (in rupees) per unit from factories  $S_1, S_2, S_3$  to warehouses  $D_1, D_2, D_3$  and  $D_4$  are given in the following table. **07**

|                | $D_1$ | $D_2$ | $D_3$ | $D_4$ | Capacity<br>(in units) |
|----------------|-------|-------|-------|-------|------------------------|
| $S_1$          | 19    | 30    | 50    | 10    | 7                      |
| $S_2$          | 70    | 30    | 40    | 60    | 9                      |
| $S_3$          | 40    | 8     | 70    | 20    | 18                     |
| Demand (units) | 5     | 8     | 7     | 14    | 34                     |

Find out the initial solution using LCM and VAM.

- (b)** Obtain the Dual of the following Primal LP problem: **07**

$$\text{Minimize } Z = x_1 - 3x_2 - 2x_3$$

Subject to the following constraints:

$$3x_1 - x_2 + 2x_3 \leq 7$$

$$2x_1 - 4x_2 \geq 12$$

$$-4x_1 + 3x_2 + 8x_3 = 10$$

and  $x_1, x_2, \geq 0$ ;  $x_3$  unrestricted

**OR**

- Q.3 (a)** Consider the problem of assigning 5 jobs to 5 persons. The costs are given as below: **07**

|   | JOBS |    |    |    |    |
|---|------|----|----|----|----|
|   | 1    | 2  | 3  | 4  | 5  |
| A | 10   | 5  | 13 | 15 | 16 |
| B | 3    | 9  | 18 | 13 | 6  |
| C | 10   | 7  | 2  | 2  | 2  |
| D | 7    | 11 | 9  | 7  | 12 |
| E | 7    | 9  | 10 | 4  | 12 |

Determine the optimum assignment schedule and minimum cost by HAM.

- (b)** What is simulation? Explain the Monte Carlo Method in brief. **07**

- Q.4 (a)** Consider the game with the following payoff matrix: **07**

| Player – A | Player – B |       |       |       |       |
|------------|------------|-------|-------|-------|-------|
|            | $B_1$      | $B_2$ | $B_3$ | $B_4$ | $B_5$ |
| $A_1$      | -2         | 0     | 0     | 5     | 3     |
| $A_2$      | 3          | 2     | 1     | 2     | 2     |
| $A_3$      | -4         | -3    | 0     | -2    | 6     |
| $A_4$      | 5          | 3     | -4    | 2     | 6     |

- (i) Determine the saddle point
- (ii) Determine the value of game
- (iii) Determine the optimal strategies for players A and B
- (iv) Is the game fair? Why?
- (v) Is the game strictly determinable? Why?

(b)

The precedence relationships of the activities, and activity time estimates (in Days) of a project is as follows:

07

| Activity | Predecessors | Duration (days) |
|----------|--------------|-----------------|
| A        | --           | 6               |
| B        | A            | 4               |
| C        | B            | 7               |
| D        | A            | 2               |
| E        | D            | 4               |
| F        | E            | 10              |
| G        | --           | 2               |
| H        | G            | 10              |
| I        | J, H         | 6               |
| J        | --           | 13              |
| K        | A            | 9               |
| L        | C, K         | 3               |
| M        | I, L         | 5               |

- (a) Draw a network diagram for this project
- (b) Find out 'Earliest Start Time' and 'Latest Finish Time' for each activity.
- (c) Indicate the critical path

OR

Q.4 (a) Explain the following:

07

- (i) Alternative (or Multiple) Optimal Solution
- (ii) Unbounded Solution
- (iii) Maximin Value and Minimax Value
- (iv) Value of Game
- (v) Saddle Point
- (vi) Event
- (vii) Activity

(b) Each unit of an item costs a company Rs. 40. Annual holding costs are 18% of unit cost for interest charges, 1% for insurance, 2% allowance for obsolescence, Rs. 2 building overheads, Rs. 1.50 for damages and loss and Rs. 4 miscellaneous costs. The annual demand for the item is constant at 1,000 units. Placing each order costs the company Rs. 100. Find out -

07

- (i) The optimal/economic order quantity
- (ii) The optimal order cycle time
- (iii) Optimal number of orders in one year
- (iv) The optimal / minimal total variable inventory cost
- (v) The optimal total inventory cost
- (vi) If the supplier of the item will only deliver batches of 250 units, how are the stock holding costs affected?
- (vii) If the supplier relaxes his order size requirement, but the company has limited warehouse space and can stock a maximum of 100 units at any time, what would be the optimal ordering policy and associated costs?

- Q.5 (a)** 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 customer per hour. Answer the following: **07**
- What is the average number of customers waiting for the service of the clerk?
  - What is the average time a customer has to wait before being served?
  - What is the probability of 3 customers waiting in the queue?
  - What is the expected number of customers in the queue?

- (b)** The data collected in running a machine-A, the cost of which is Rs. 60,000, is given below: **07**

| Year                 | 1      | 2      | 3      | 4      | 5      |
|----------------------|--------|--------|--------|--------|--------|
| Resale Value (Rs.)   | 42,000 | 30000  | 20,400 | 14,400 | 9,650  |
| Cost of spares (Rs.) | 4,000  | 4,270  | 4,880  | 5,700  | 6,800  |
| Cost of labour (Rs.) | 14,000 | 16,000 | 18,000 | 21,000 | 25,000 |

Determine the optimum period for replacement of the machine.

**OR**

- Q.5 (a)** Find an optimal sequence for the following sequencing problem of four jobs and five machines, when passing is not allowed. Its processing time (in hours) is given below: **07**

| Job | Machine        |                |                |                |                |
|-----|----------------|----------------|----------------|----------------|----------------|
|     | M <sub>1</sub> | M <sub>2</sub> | M <sub>3</sub> | M <sub>4</sub> | M <sub>5</sub> |
| A   | 7              | 5              | 2              | 3              | 9              |
| B   | 6              | 6              | 4              | 5              | 10             |
| C   | 5              | 4              | 5              | 6              | 8              |
| D   | 8              | 3              | 3              | 2              | 6              |

Also find the total elapsed time and idle time.

- (b)** Machine A costs Rs. 45,000 and its operating costs are estimated to be Rs. 1,000 for the first year increasing by Rs. 10,000 per year in the second and subsequent years. Determine the optimal period for replacement of the machine. Another Machine B has the lowest average annual running cost of Rs. 20,000 in the 5<sup>th</sup> year of life. If at present we have a machine of type A, should we replace it with B? If so, when? Assume that both the machines have no resale value and their future costs are not discounted. **07**

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