

**M. SC. (APPLIED STATISTICS)  
(MSCAST)**

**Term-End Examination**

**June, 2026**

**MSTE-011 : OPERATIONS RESEARCH**

*Time : 3 Hours*

*Maximum Marks : 50*

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**Note :** (i) *Question No. 1 is compulsory.*

(ii) *Attempt any **four** questions from the remaining question nos. 2 to 6.*

(iii) *Use of scientific (non-programmable) calculator is allowed.*

(iv) *Symbols have their usual meanings.*

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1. State whether the following statements are True or False. Give reasons in support of your answers :

$$5 \times 2 = 10$$

- (a) All basic variables in an LPP have

$$Z_j - C_j = 0.$$

- (b) Using dual simplex method we can never have an unbounded solution.
  - (c) Stepping stone method is useful for those problems which have more than one source.
  - (d) In solving a sequencing problem, the objective is to determine the sequence in which the jobs may be performed so that the total elapsed time is maximized.
  - (e) Lead time is the elapsed time between the initiation of an order and the receipt of replenishment stock.
2. (a) Obtain the dual of the following L.P.P. :
- Maximize  $Z = 3x_1 + x_2 + x_3 - x_4$
- subject to the constraints : 5
- $x_1 + 5x_2 + 3x_3 + 4x_4 \leq 5,$
- $x_1 + x_2 = -1$
- $x_1, x_2, x_3, x_4 \geq 0,$
- $x_3 - x_4 \leq -5.$

- (b) Solve the following transportation problem by Vogel's approximation method : 5

| Origin         | Destination    |                |                |                | Availability |
|----------------|----------------|----------------|----------------|----------------|--------------|
|                | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> | D <sub>4</sub> |              |
| O <sub>1</sub> | 1              | 2              | 1              | 4              | 30           |
| O <sub>2</sub> | 3              | 3              | 2              | 1              | 50           |
| O <sub>3</sub> | 4              | 2              | 5              | 9              | 20           |
| Requirement    | 20             | 40             | 30             | 10             | 100          |

3. (a) Solve the following assignment problem : 5

|   | I  | II | III | IV | V  |
|---|----|----|-----|----|----|
| 1 | 11 | 17 | 8   | 16 | 20 |
| 2 | 9  | 7  | 12  | 6  | 15 |
| 3 | 13 | 16 | 15  | 12 | 16 |
| 4 | 21 | 24 | 17  | 28 | 26 |
| 5 | 14 | 10 | 12  | 11 | 15 |

- (b) Solve the following game : 5

$$\text{Player A} \begin{bmatrix} -1 & 2 & 1 \\ 1 & -2 & 2 \\ 3 & 4 & -3 \end{bmatrix}$$

Player B

4. (a) Find the sequence that minimizes the total elapsed time required to complete the following tasks on two machines : 5

| Task | Machine I | Machine II |
|------|-----------|------------|
| A    | 2         | 6          |
| B    | 5         | 8          |
| C    | 4         | 7          |
| D    | 9         | 4          |
| E    | 6         | 3          |
| F    | 8         | 9          |
| G    | 7         | 3          |
| H    | 5         | 8          |
| I    | 4         | 11         |

- (b) A firm is using a machine whose purchase price is ₹ 13,000. The installation charges amount to ₹ 3,600 and the machine has a scrap value of only ₹ 1,600, because the firm has a monopoly of this type of work. The

maintenance costs in various years are as follows :

| Year | Maintenance Cost (₹) |
|------|----------------------|
| 1    | 250                  |
| 2    | 750                  |
| 3    | 1000                 |
| 4    | 1500                 |
| 5    | 2100                 |
| 6    | 2900                 |
| 7    | 4000                 |

The firm wants to determine after how many years should the machine be replaced on economic considerations, assuming that the machine replacement can be done only at the year ends. 5

5. (a) Customers arrive at a box office-window, being manned by single individual, according to a Poisson input process with a mean rate of 30 per hour. The time required to serve a customer has an exponential distribution with a mean of 90 seconds. Find the average number of customers in the system and average queue length. 5

(b) Suppose you need to supply 100 units of a certain product every Monday to your customer. You obtain the product from a local supplier at Rs. 60 per unit. The cost of ordering and transportation from the supplier are 150 per order. The cost of carrying inventory is estimated at 15% per year of the cost of the product carried :

(i) Find the lot size, which will minimise the cost of the system.

(ii) Determine the optimum cost. 5

6. Use simplex method to solve the following L.P.P. : 10

$$\text{Maximize } Z = x_1 - x_2 + 3x_3$$

Subject to constraints :

$$x_1 + x_2 + x_3 + 3 \leq 10$$

$$2x_1 - x_3 \leq 2$$

$$2x_1 - 2x_2 + 3x_3 \leq 0;$$

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

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