No. of Printed Pages : 7 **MSTE-011**

M. SC. (APPLIED STATISTICS)

(MSCAST)

Term-End Examination

December, 2025

MSTE-011 : OPERATIONS RESEARCH

Time : 3 Hours *Maximum Marks : 50*

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.

1. State whether the following statements are True *or* False. Give reasons in support of your answers : 5×2=10

   (a) All non-basic variables in an LPP have $z_j - c_j = 0$.

(b) Dual simplex method always leads to degenerate basic feasible solution.

(c) Only those problems where total demand equals to the total supply can be solved by MODI method.

(d) The optimum sequence in a 2-machine problem, minimizes the ideal time on the machine on which the jobs are performed later.

(e) EOQ results in equalisation of annual inventory carrying cost and procurement cost.

2. (a) Formulate the dual of the following LPP : 5

Maximise :

$$z = 5x_1 + 3x_2$$

subject to the constraints :

$$3x_1 + 5x_2 \leq 15$$

$$5x_1 + 2x_2 \leq 10$$

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

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

	D_1	D_2	D_3	D_4	a_i
Q_1	5	8	6	2	19
Q_2	4	7	9	1	37
Q_3	3	4	7	5	34
b_i	16	18	31	25	90

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

	1	2	3	4
A	10	12	19	11
B	5	10	17	8
C	12	14	13	11
D	18	15	11	9

(b) Solve the following (3 × 3) game : 5

$$\begin{bmatrix} 7 & 1 & 7 \\ 9 & -1 & 1 \\ 5 & 7 & 6 \end{bmatrix}$$

4. (a) Six jobs go first over machine I and then over machine II. The order of the completion of jobs has no significance. The following table gives the machine times in hours for six jobs and the two machines :

Job No.	**Time on Machine I (A_i)**	**Time on Machine II (B_i)**
1	5	7
2	9	4
3	4	8
4	7	3
5	8	9
6	6	5

Find the sequence of jobs that minimises the total elapsed time to complete the jobs. 5

(b) A firm is considering replacement of a machine, whose cost price is ₹ 12,200 and the scrap value is only ₹ 200. The maintenance cost (in rupees) are found from past experience given as follows : 5

Year	Maintenance Cost
1	200
2	500
3	800
4	1200
5	1800
6	2500
7	3200
8	4000

When should the machine be replaced ?

5. (a) A drive in bank window has a mean service time of 2 minutes, while the customers arrive at a rate of 20 per hour. Assuming that, these service and arrival rates follow Poisson distribution, determine : 5

(i) The proportion the teller will be idle.

(ii) How long a customer will wait before reaching the server ?

(iii) What fraction of customers will have to wait in line ?

(iv) The probability that a customer has to wait ?

(b) A company plans to consume 760 pieces of a particular component. Past records indicate that purchasing department spent ₹ 12,555 for placing 15500 purchase orders. The inventory was valued at ₹ 45,000 and the total storage cost was ₹ 7,650 which included wages, rent, taxes, insurance etc., related to store department. The company borrows capital at the rate of 10% per year.

If the price of a component is ₹ 12 and lot size is 10, find the following : 5

(i) Purchase price per year,

(ii) Purchase expenses per year,

(iii) Storage expenses per year,

(iv) Capital cost per year,

(v) Total cost per year

6. Use simplex method to : 10

Maximise :

$$z = 5x_1 + 4x_2$$

subject to the constraints :

$$4x_1 + 5x_2 \leq 10$$

$$3x_1 + 2x_2 \leq 9$$

$$8x_1 + 3x_2 \leq 12$$

$$x_1 \geq 0 \text{ and } x_2 \geq 0.$$

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