

No. of Printed Pages : 6

MSTE-011

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

Term-End Examination

June, 2025

MSTE-011 : OPERATIONS RESEARCH

Time : 3 Hours

Maximum Marks : 50

Note : *Question No. 1 is compulsory. Attempt any **four** questions from the remaining question nos. 2 to 6. Use of scientific (non-programmable) calculator is allowed. Symbols have their usual meanings.*

1. State whether the following statements are True or False. Give reasons in support of your answers : $5 \times 2 = 10$
 - (a) The coefficient of slack/surplus variables is non-zero in the objective function.

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- (b) Dual simplex method is not applicable to LPP, if initial basic feasible solution is not optimum.
 - (c) Allocation to dummy destination represents the surplus at the supply point.
 - (d) The optimum sequence is one where jobs are processed on first-come-first-served basis.
 - (e) Inventory cycle is the time period occurring between successive procurement system (actions).
2. (a) Write the dual of the following LPP : 5
- Minimize :

$$Z = 4x_1 + 6x_2 + 18x_3$$

subject to the constraints :

$$x_1 + 3x_2 \geq 3$$

$$x_2 + 2x_3 \geq 5$$

and $x_j \geq 0$ ($j = 1, 2, 3$)

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

Source	Destination				Availability
	1	2	3	4	
1	21	16	25	13	11
2	17	18	14	23	13
3	32	27	18	41	19
	6	10	12	15	43

3. (a) Solve the following assignment problem which minimizes the total men hours : 5

	Men			
	A	B	C	D
1	10	25	15	20
2	15	30	5	15
3	35	20	12	24
4	17	25	24	20

- (b) Use arithmetic method to solve the following (3×3) game : 5

0	1	2
2	0	1
1	2	0

4. (a) We have five jobs, each of which must go through the two machines A and B in the order $A \rightarrow B$. Processing times in hours are given in the table : 5

Job (i)	1	2	3	4	5
Machine A (A_i)	5	1	9	3	10
Machine B (B_i)	2	6	7	8	4

Determine a sequence for five jobs that will minimize the elapsed time.

- (b) The cost of a machine is ₹ 6,100 and its scrap value is ₹ 100. The maintenance costs found from past experience are as follows : 5

Year	Maintenance Cost (in ₹)
1	100
2	250
3	400
4	600
5	900
6	1,200
7	1,600
8	2,000

When should the machine be replaced ?

5. (a) In a super market, the average arrival rate of the consumers is 5 every 30 minutes. The average time it takes to list and calculate the consumer's purchases at the cash desk is 4.5 minutes, and this time is exponentially distributed. 5
- (i) How long will the customer expect to wait for service at the cash desk ?
- (ii) What is the chance that the queue length will exceed 5 ?
- (iii) What is the probability that the cashier is working ?
- (b) The demand for a particular item is ₹ 18,000 units per year. The holding cost per unit is ₹ 1.20 year and cost of one procurement is ₹ 400. No shortage are allowed and the replacement rate is instantaneous. 5

Determine :

- (i) Optimum order quantity
- (ii) Number of orders per year
- (iii) Time between orders
- (iv) Total cost per year, when the cost of one unit is Re. 1.

6. Use simplex method to : 10

Maximize :

$$Z = 3x_1 + 5x_2$$

subject to the constraints :

$$3x_1 + 2x_2 \leq 18$$

$$0 \leq x_1 \leq 4$$

$$0 \leq x_2 \leq 6.$$

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