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 : 5×2=10

   (a) The coefficient of slack/surplus variables is non-zero in the objective function.

(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 :

$$x_1 + 3x_2 \geq 3$$

$$x_2 + 2x_2 \geq 5$$

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

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

Source	Destination 1	2	3	4	Availability
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

Jobs	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

$$\begin{bmatrix} 0 & 1 & 2 \\ 2 & 0 & 1 \\ 1 & 2 & 0 \end{bmatrix}$$

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 :

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

$$0 \leq x_1 \leq 4$$

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

× × × × ×