No. of Printed Pages : 8 **MSTE–001**

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

June, 2025

MSTE-001 : INDUSTRIAL STATISTICS—I

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* ***7****.*

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

(iv) Use of Formulae and Statistical Tables Booklet for PGDAST is allowed.

(v) 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) If process variability (6σ) is greater than the tolerance (USL-LSL), then the process is capable to produce the units under specifications.

   (b) For the following game :

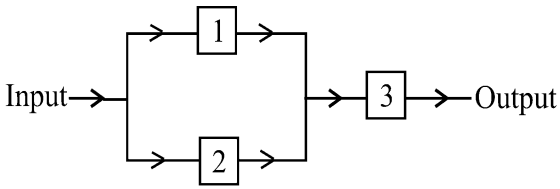
		Player B		
		B_1	B_2	B_3
Player A	A_1	3	5	2
	A_2	2	0	– 2
	A_3	4	– 1	1

   the value of the game is 4.

   (c) If a lot is accepted on the basis of the rectifying sampling plan, then :

$$ATI = ASN$$

   (d) The reliability block diagram of a system is as shown below :



   The path sets :

   $P_1 = \{1, 3\}$, $P_2 = \{2, 3\}$, $P_3 = \{1, 2, 3\}$

   are minimal path sets.

(e) The u-chart for quality control is used for fraction defectives.

2. A company started a process of making copper plates. In order to check the diameter of the plates is under control, the quality control team takes a random sample of 8 plates after each hour. The sample mean ($\bar{X}$) and sample range (R) are calculated for each selected sample and are given as follows :

Sample No.	$\bar{X}$	R
1	3.57	0.62
2	3.72	1.25
3	3.41	0.95
4	3.48	0.45
5	3.62	1.22
6	3.70	0.62
7	3.56	1.00
8	3.91	0.80
9	3.62	0.74
10	3.41	0.68

11	3.72	1.23
12	3.55	2.25
13	3.42	1.06
14	3.64	0.94
15	3.56	1.40

Construct the suitable control charts for process variability and process mean. State whether the process is under statistical control. If not, compute revised control limits. 10

3. (a) Suppose a consumer receives lots of 200 electric bulbs from a new supplier. To check quality of lot, the consumer draws a random sample of 10 bulbs and accepts the lot, if atmost one bulb is defective, otherwise the lot is rejected. 8

   (i) Find probability of accepting the lot if incoming lot quality is 5%.

   (ii) If AQL = 0.05 and LTPD = 0.10, find producer's risk and consumer's risk.

(iii) If incoming lot quality is 4%, find AOQ under acceptance as well as rectifying sampling plan.

(b) What are the differences between control charts for variables and attributes ? 2

4. A two-person zero-sum game has the following pay-off matrix for player A : 10

		Player B			
		B_1	B_2	B_3	B_4
Player A	A_1	6	3	5	7
	A_2	4	5	5	5
	A_3	5	3	5	1
	A_4	1	5	1	5

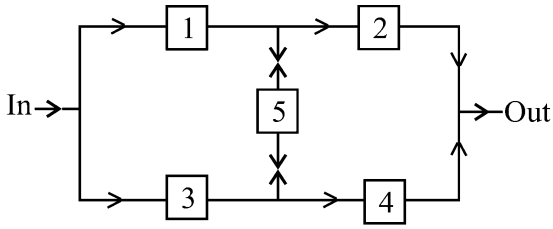
(i) Does there exist a saddle point ?

(ii) Use dominance rules to reduce the size of the following pay-off matrix to (2×2) size and hence, find the optimal strategies for players A and B.

(iii) Are the optimal strategies pure ? If not, give reason.

(iv) Find the value of the game, if game is fair.

5. (a) A system has five independent components each has reliability 0.70 for a mission of 500 hours. The system configuration is shown below : 8



Evaluate the reliability of the system.

(b) Define redundancy. 2

6. A company faced a problem of a decline in its sales turnover. To overcome this problem, it has decided to opt for any of the four strategies : heavy advertisement (S_1), increase in number of sales executives (S_2), adding new features to products (S_3), and increasing the price of the product (S_4). Out of these four strategies, there may be four possible states of natures which are : 40% increase in sales (E_1), 30% increase in sales (E_2), 25% increase in sales (E_3) and 22% increase in sales (E_4). The company executives have worked out the yearly net

profit (in thousand rupees) that would result if any of the four strategies are selected. This is presented as follows :

State of Nature	Strategy			
	S_1	S_2	S_3	S_4
E_1	100	250	850	500
E_2	200	500	300	700
E_3	400	600	600	200
E_4	600	800	350	500

On the basis of this information, identify the optimum course of action under the following criteria : 10

(i) Optimistic criterion

(ii) Pessimistic criterion

(iii) Hurwicz criterion for $\alpha = 0.7$

(iv) Regret criterion

(v) Laplace criterion

7. (a) A hospital receives disposable injection syringes in lots of 500. A double sampling plan with $n_1 = 10, c_1 = 0$, $n_2 = 25, c_2 = 1$ is being used to test the quality of the lots. If the incoming lot quality is 0.04, calculate the probability of accepting the lot on the basis of second sample. 5

(b) A quality control technician has recorded the number of defects per 10 square metre of a wallpaper. If number of defects in 10 such inspections are as follows :

Inspection No.	No. of Defects
1	6
2	8
3	12
4	5
5	10
6	7
7	6
8	18
9	4
10	2

calculate the control limits of suitable control chart and state whether the process is under statistical control or not. 5

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