

INDIAN STATISTICAL INSTITUTE

MS in QMS

TEST ON STATISTICAL PROCESS CONTROL

Date: 09 September 2025 Time: 2 hours Maximum Marks: 50

Answer as many questions as you can. The maximum you can score is 50

1. A TiW layer is deposited on a substrate using a sputtering tool. The table below presents the subgroup means and ranges of layer thickness measurements (in Angstroms) for 20 subgroups, each consisting of four substrates.

Subgroup	xbar	R	Subgroup	xbar	R
1	448.25	24	11	447.00	15
2	441.75	3	12	451.50	21
3	448.50	13	13	448.00	18
4	455.75	31	14	448.50	27
5	449.75	14	15	452.00	22
6	453.25	13	16	445.75	18
7	447.25	5	17	454.50	10
8	450.50	9	18	429.75	15
9	448.25	17	19	451.25	23
10	450.25	31	20	452.00	4

- Set up an \bar{X} and R chart for this process. Draw the control charts and determine whether the process is in statistical control?
- Estimate the mean and standard deviation of the process?
- If the specifications are 450 ± 15 , what conclusions can you draw about the process's ability to produce items within these specifications?
- Assuming that items exceeding the upper specification limit can be reworked, and those falling below the lower specification limit must be scrapped, what are the percentages of scrap and rework?

[12]

2. State and prove the Central Limit Theorem. What are the applications of the Central Limit Theorem in Statistical Process Control (SPC)?

[12]

3. Derive the moment-generating function (MGF) of the Poisson distribution. Prove that the mean and variance of a Poisson-distributed random variable are equal

[12]

4. The data in table below represent the results of inspecting all units of a personal computer produced in the past ten days.

Day	Units Inspected	Nonconforming Units
1	80	4
2	110	7
3	90	5
4	85	6
5	130	6
6	120	6
7	70	4
8	125	5
9	105	7
10	95	7

- a. Set up a fraction nonconforming control chart? Plot the points on the chart? Does the process appear to be in control?
- b. The table below contains the results of six additional samples collected after the initial control chart was established. Plot this data on the fraction nonconforming chart. Is the process still in control?

Day	Units Inspected	Nonconforming Units
11	80	6
12	100	5
13	79	8
14	70	5
15	120	7
16	85	8

[12]

5. Write short note on any one of the following:
- a. Chance and Assignable causes of variation
- b. Rational Subgrouping

[5]