

Indian Statistical Institute, Bangalore

MS (QMS) First Year

Second Semester - Advanced Statistical Process Control

Midterm Exam

Date: February 24, 2020

Maximum marks: 50

Duration: 2 hours

Answer as many Questions as you can. The maximum marks you can score is 50.

1. A machine with 3 heads producing the same part. The following table shows that the data collected from each head for 10 subgroups. Construct a suitable control chart for process control. [10]

Subgroup No.	Head 1	Head 2	Head 3
1	4.5	4.7	4.5
2	4.6	5	4.9
3	4.7	5.1	5.3
4	4.9	4.4	5.5
5	4.3	4.2	5.2
6	4	4	4.8
7	3.9	4	4
8	3.9	3.8	3.9
9	4.2	3.9	4
10	4.6	4	4.2

2. An injection moulding machine producing several similar large parts in small batches. The parts undergo 100% inspection. The following data shows how many parts were sent for rework.

Analyze the data by a suitable control chart method.

[15]

Part No.	No. Checked	No. Reworked
A	45	6
B	29	6
A	54	9
B	33	5
A	65	12
B	21	7
A	56	12
B	36	4
A	68	14
B	30	5
A	70	18
B	28	1
A	65	13
B	44	7
B	39	6
B	32	4

3. Write short notes on (any three):-

[5 x 3 =15]

- a) Hotelling T^2 control chart method (for subgroup and individual data).
- b) Standardized \bar{x} , R control chart.
- c) SPC implementation methodology.
- d) Attribute control charts for short run production.

4. A normally distributed quality characteristic is monitored by \bar{x} , R chart (n = 4) with the following control limits. [2 + 3 = 5]

R - chart	\bar{x} - chart
LCL = 0	LCL = 614
CL = 8.236	CL = 620
UCL = 18.795	UCL = 626

a) Calculate c_p, c_{pk} (Spec 610 ± 15).

b) Calculate fraction nonconformity with the above limit.

5. A product has 2 observable quality characteristic x_1 and x_2 . 50 preliminary sample of subgroup size n=25 was used to estimate the mean and the covariance matrix. [4 + 6 = 10]

$$\bar{x} = \begin{bmatrix} 32 \\ 15 \end{bmatrix}, \quad s = \begin{bmatrix} 180 & 110 \\ 110 & 130 \end{bmatrix}$$

a) Compute the limit of future control.

b) Suggest whether the following process averages are in control. ($\alpha = 0.05$).

$$\bar{x}_1 \quad \bar{x}_2$$

$$38 \quad 18$$

$$22 \quad 19$$