INDIAN STATISTICAL INSTITUTE

MS QMS

STATISTICAL PROCESS CONTROL

Date: 12 November, 2014 Time: 3 hours Maximum Marks: 50

Answer any five questions

1.

a. Define the process capability indices *Cp* and *Cpk*? Suppose a process is operating with *Cp* > 1 and *Cpk* < 1, as a quality engineer, what suggestions can you give to improve the process?

b. Control charts for *xbar* and *range* are to be established to control the tensile strength of a metal part. Assume that the tensile strength is normally distributed. Thirty samples of size *n* = 6 parts are collected over a period of time with the following results:

$$\sum_{i=1}^{30} \bar{x}_i = 6010 \text{ and } \sum_{i=1}^{30} R_i = 150$$

i. Compute the control limits for *xbar* and *R* chart

ii. Assume both charts exhibits control. If the specification on tensile strength is 200 ± 5, calculate the *Cp* and *Cpk*? Interpret the results?

iii. Calculate the total percentage of nonconforming parts?

[10]

2. The number of nonconforming switches in samples of size 150 is given below. Construct a number nonconforming control chart? Does the process appear to be in control? If not assume that assignable causes can be found for all points outside the control limits and calculate the revised control limits?

Sample Number	Number Nonconforming	Sample Number	Number Nonconforming
1	8	11	6
2	1	12	0
3	3	13	4
4	0	14	0
5	2	15	3
6	4	16	1
7	0	17	8
8	1	18	2
9	8	19	3
10	6	20	0

[10]

3.

a. Explain Repeatability and Reproducibility?

b. A measurement system study is carried out using 20 parts, 2 operators and 2 measurements (replication) per part. The *ANOVA* table computed based on the data collected for the study is given below. Estimate the Repeatability and Reproducibility? How much is the total Gauge R & R? Is the measurement system acceptable?

Source of Variation	SS	df	MS	F	F Crit
Sample (Part)	783.3	19	41.226	90.035	1.85
Column (Operator)	1.8	1	1.800	3.931	4.08
Interaction	8.7	19	0.458	0.509	1.85
Within	36	40	0.900		
Total	829.8	79			

[10]

4.

a. Write a short note on Pre Control?

b. The summary data on an attribute gage study conducted on a call monitoring process is given below. Compute kappa and interpret the results?

		Auditor 2	
		Pass	Fail
Auditor 1	Pass	16	2
	Fail	2	5

[10]

5.

a. Explain rectifying inspection? Give formula for computing Average Outgoing Quality (*AOQ*) and Average Total Inspection *(ATI*)?

b. Suppose that a product is shipped in lots of size N = 5000. The receiving inspection procedure used is single sampling with n = 50 and c = 1. Suppose p = *0.01* be the fraction defective in the lot. Calculate probability of acceptance *Pa*, Average Outgoing Quality *AOQ* and Average Total Inspection *ATI*?

[10]

6.

a. Give switching procedure between normal, tightened and reduced inspection in MIL STD 105E?

b. MIL STD 105E is being used to inspect incoming lots of size N = 5000. Single sampling, general inspection level II and *AQL* of 0.65% are being used. Find normal, tightened and reduced inspection plans?

[10]