

**Indian Statistical Institute, Bangalore**  
**M.S. (QMS) First Year**  
**First Semester – Statistical Process Control II**

Mid Term Exam

Duration: 2 Hrs

Date: February 17, 2017

Max Marks: 50

1. [6 + 4 = 10]

(a) Describe the procedure of SPC implementation in a process?

(b) Identify five possible benefits of SPC implementation.

2. [3 + 3 + 3 = 9]

(a) Give example of three different process situations, in which the concept of Group Control Chart can be implemented.

(b) For a measurable characteristic with subgroup size 1, calculate the limit of Group Control Chart for the following cases.

(i) Five different parts are produced by the same machine with same target value, but different tolerance limit.

(ii) Five different parts are produced by the same machine having different target value as well as tolerance limit.

3. A plant producing different variety of the same product by using the same process batch-wise. 100% of the products are inspected after manufacturing, and the following data was collected. Analyze the data by using a suitable control chart and comment about the process. [10]

Day	Variety	No. Inspected	No. Rejected
1	A	239	13
1	B	169	7
2	B	299	17
2	C	241	18
3	A	250	7
3	B	185	12
4	B	207	7
4	C	317	23
4	A	96	2
5	A	298	14
5	B	200	18
5	C	132	4
6	A	375	23
6	C	150	11

7	B	384	14
7	A	195	11
8	C	307	19
8	A	144	14
9	B	413	24
10	A	137	14
10	C	239	17

4. Derive pre-control chart limit for a continuous characteristic, which follows Normal distribution and the  $c_p$  value of the process is 1.5 for that characteristic. [6]

5. [3 + 3 + 3 + 5 = 14]

(a) Define the control limit and the process control procedure of Hotelling  $T^2$  control chart for two characteristics.

(b) Write down Phase I and Phase II limit of  $T^2$  control chart for  $p$  variate when subgroup size is 1.

(c) Describe the merits and demerits of multivariate control procedure.

(d) A process has two quality characteristics. The nominal values of these quality characteristics and their sample covariance matrix has been determined from the analysis of 25 preliminary samples of size of  $n = 10$ ,

$$\bar{\bar{X}} = \begin{bmatrix} 3.2 \\ 2.5 \end{bmatrix} \quad S = \begin{bmatrix} 1.26 & 0.88 \\ 0.88 & 1.21 \end{bmatrix}$$

The sample means for each quality characteristic for five more samples are collected by using sample of  $n = 10$ . Is the process is under statistical control?

Sample No.	$\bar{x}_1$	$\bar{x}_2$
1	3.0	2.2
2	4.7	3.2
3	4.0	2.9
4	3.6	2.8
5	3.2	2.1

6. Give example of the dominance system and define the method of process control for each case. [6]

(i) Machine Dominant

(ii) Raw Material Dominant

(iii) Setup Dominant