TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied and Health Sciences

DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATIONS 2016/2017 FOR THE DEGREE IN;

BACHELOR OF SCIENCE IN STATISTICS AND COMPUTING AND

BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTING YEAR IV

SEMESTER I

AMA 4433: QUALITY CONTROL METHODS

DATE: DECEMBER 2016 ____________________ **DURATION:** 2 HOURS

QUESTION ONE (30MKS)

a) Outline any four major problem-solving tools of statistical process control (SPC) **(4mks)**

b) 20 tape recorders were examined for quality control test. The number of defects for each tape recorded were as follows

2, 4, 3, 1, 1, 2, 5, 3, 6, 7, 3, 1, 4, 2, 1, 3, 4, 6, 1, 1

i. Prepare a control chart for the set **(6mks)**

ii. What is the statistical comment that can be drawn from the chart above? **(2mks)**

c) Explain any three reasons for the popularity of the control charts as a statistical process control tool **(3mks)**

d) In an electronic manufacturing process a current has a specification of 100 ±10 mA the process mean and standard deviation are 107.0 and 1.5 respectively.

i. Calculate process capability ratio (PCR) (4mks)

ii. Use the calculated value to make a statistical decision on a specification limits (1mk)

e) Define the term acceptable quality level (**AQL**) as used in sequential sampling plans **(1mk)**

f) Twenty five samples of size 5 are drawn from a process at one hour intervals and the following data $\sum_{i=1}^{35} \bar{X}_i$=362.5, $\sum_{i=1}^{35} r_i$=8.6 and $\sum_{i=1}^{35} S_i$=3.64 summarizes the analysis of observation, find the trial control limits for $\bar{X}$ and S charts **(4mks)**

g) Construct a pareto- chart showing the relative frequency of defect for the set of data below **(4mks)**

Defects	Dirt in paint	Sag	Orange peel	Thin paint	Sealer under	Scratch	Off colour
No. of defects	65	21	12	5	4	2	1

QUESTION TWO (20MKS)

a) Explain any four precautions taken while designing a control chart **(4mks)**

b) Define an operating characteristic curves (1mk)

c) Explain the steps followed in preparing an operating characteristic curve (3mks)

d) A muffler shop receives a 1000 mufflers, the sampling plan for sampling mufflers uses size n=60 and acceptance number C=1, the contract with the muffler manufacturer calls for an AQL of 1 defective muffler per 100 items,

i. Calculate the operating characteristic curve for this plan (8mks)

ii. Determine the producers risk for this plan (2mks)

iii. Determine the consumers risk for this plan (2mks)

QUESTION THREE (20MKS)

a) Define the following terms as used in sampling plans **(2mks)**

i. Specification limit

ii. tolerance

b) Measuments from a key characteristic yield gives the following 20 values

62, 62, 60, 59, 61, 64, 57, 62, 64, 59, 60, 61, 60, 63, 59, 58, 60, 56, 60, 56

Calculate

i. The average of all measurements **(3mks)**

ii. standard deviation for the set **(4mks)**

iii. Upper specific limit USL **(1mk)**

iv. Lower specific limit LSL **(1mk)**

v. Engineering tolerance given the engineering specifications above **(1mk)**

vi. The capability of the process **(2mks)**

vii. Cp ratio **(3mks)**

viii. Cpk ratio **(3mks)**

QUESTION FOUR (20MKS)

a) Describe any four situations where the sample size used for process control may consist of an individual unit **(4mks)**

b) Show the proof that the value of the lower control limit (LCL) for control chart showing individuals of moving ranges is zero **(4mks)**

c) The table below shows observations for the output of a chemical process taken at one hour

Observation	Concentration X	moving ranges mr
1	102.0	
2	94.8	---
3	98.3	3.5
4	98.4	0.1
5	102.0	---
6	98.5	3.5
7	99.0	0.5
8	97.7	---
9	100.0	2.3
10	98.1	1.9
11	101.3	3.2
12	98.7	2.6
13	101.1	2.4
14	98.4	---
15	97.0	1.4
16	96.7	0.3
17	100.3	3.6
18	101.4	---
19	97.2	4.2
20	101.0	3.8

i. Complete the table for the missing moving ranges **(2mks)**

ii. Compute the trial control limits for individual observation and moving range charts (4mks)

iii. By plotting the data construct the chart for moving averages **(5mks)**

iv. Determine whether the process is in statistical control or not **(1mk)**

QUESTION FIVE (20MKS)

a). Differentiate between consumers risk and producers risk **(2mks)**

b) Given 20 observations for each of the five chemical manufacturing process are as shown below

Sample	x_1	x_2	x_3	x_4	x_5	$\bar{x}$	r	s
1	33	29	31	32	33	31.6	4	1.67332
2	33	31	35	37	31	33.4	6	2.60768
3	35	37	33	34	36	35.0	4	1.58114
4	30	31	33	34	33	32.2	4	1.64317
5	33	34	35	33	34	33.8	2	0.83666
6	38	37	39	40	38	38.4	3	1.14018
7	30	31	32	34	31	31.6	4	1.51658
8	29	39	38	39	39	36.8	10	4.38178
9	28	33	35	36	43	35.0	15	5.43139
10	38	33	32	35	32	34.0	6	2.54951
11	28	30	28	32	31	29.8	4	1.78885
12	31	35	35	35	34	34.0	4	1.73205
13	27	32	34	35	37	33.0	10	3.80789
14	33	33	35	37	36	34.8	4	1.78885
15	35	37	32	35	39	35.6	7	2.60768
16	33	33	27	31	30	30.8	6	2.48998
17	35	34	34	30	32	33.0	5	2.00000
18	32	33	30	30	33	31.6	3	1.51658
19	25	27	34	27	28	28.2	9	3.42053
20	35	35	36	33	30	33.8	6	2.38747
						$\bar{\bar{x}}$ =33.32	$\bar{r}$= 5.8	$\bar{s}$ =2.345

i. Plot a histogram to represent the chemical process (6mks)

ii. Calculate the process capability ratio for the above data (3mks)

c) In manufacturing automobile engine piston rings the inside diameter of the ring is found to have a mean of 74 mm and a standard deviation of 0.01 mm. After every hour a random sample of 5 rings are picked, obtain the

i. Standard deviation of the sample average $\bar{X}$ (3mks)

ii. The upper control limit (2mks)

iii. The lower control limit (2mks)

iv. The probability of point plots being outside the control limits when the process is in control (2mks)