(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER

SPECIAL/ SUPPLEMENTARY EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: STA 323

COURSE TITLE: QUALITY CONTROL AND ACCEPTANCE SAMPLING

DATE: 18/11/2022 **TIME:** 11:00 AM - 1:00 PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION 1: (30 Marks)

a) Give the three main objectives of a control chart **[3mks]**

b) What are the main applications of a control chart **[4mks]**

c) Briefly describe the important steps in constructing an $\bar{x} - chart$ **[6mks]**

d) Briefly compare the single sampling plan and the double sampling plan **[3mks]**

e) The data below are samples means and sample ranges for ten consecutive samples, each sample consisting of five measurements of a continuous random variable x. Assuming x is normally distributed plot $\bar{x} - control\ chart$ and comment on the degree of control

Sample No.	1	2	3	4	5	6	7	8	9	10
Sample mean	136.2	137.4	136.6	139.8	136.0	135.0	136.8	142.0	137.4	126.2
Sample Range	8	6	7	6	8	7	6	19	6	7

[6mks]

$a_n = 0.4299\ for\ \ n = 5$

f) suppose that the mean has shifted from μ to μ^* but σ^2 remain unchanged assuming normality (take $\alpha = 0.002$)

i. Find the probability that the process is under control for the $\bar{x} - chart$ **[4mks]**

ii. Show that the Average Run Length function of the $\bar{x} - chart$ is given by $\frac{1}{1-P(\theta)}$. Assuming that samples taken from the process are independent, where θ is the incoming quality **[4mks]**

QUESTION 2: (20 Marks)

a) Explain each of the following concepts

i. Average sampling numbers [ASN] **[2mks]**

ii. Average outgoing quality [AOQ] **[3mks]**

iii. Lot tolerance percent defective (LTPD) **[3mks]**

iv. Acceptance Quality Level [AQL] **[2mks]**

b) When do we use S^2- chart? Explain clearly how you can use it to determine whether a system is out of control or not. If $n = 4$ and $\alpha = 0.02$, obtain its upper action and warning limits. **[5mks]**

c) What do you understand by the moving average chart? Explain clearly how you can use it to determine whether a system is out of control or not. **[5mks]**

QUESTION 3: (20 Marks)

a) If n is large and p is moderately small and we let $\lambda = np$, obtain C-chart for the number of defectives per unit. (Take $\alpha = 0.001$ for action limit and $\alpha = 0.025$ for warning limit **[7mks]**

b) Obtain a single sampling for the proportion of defectives, fixing the producer's risk $\alpha = 0.09$ at $\theta_1 = 0.05$ and the consumer's risk $\beta = 0.1$ at $\theta_1 = 0.1$ and hence give your conclusion **[6mks]**

c) A large batch of items to be inspected using a single sampling scheme specified by the following values $n = 20,\ c = 2,\ \theta_1 = 0.02,$ and $\theta_2 = 0.1$

i. Define the operating characteristic of this sampling plan **[1mk]**

ii. Find the probability of accepting a lot of quality $\theta = 0.05$ **[2mks]**

iii. Find the consumer's risk and the producer's risk **[4mks]**

QUESTION 4: (20 Marks)

a) Workout the O.C curve and the ARL function for S^2-chart with upper warning limits given by $P[\sum(x_i - \bar{x})^2 > k] \leq 0.05$ and action is taken only if two consecutive values of S^2 fall beyond the upper warning limit (take $n = 12,\ \theta = \frac{\sigma^{2*}}{\sigma}$ and $\theta \to (-\infty, 0, \infty)$ **[6mks]**

b) Explain briefly how you use control chart for fractional defective (p −chart) to determine whether the process is in control or not and hence show its warning and action limit on a p-chart. (take $\alpha = 0.002$ for action limit and $\alpha = 0.05$ for warning limit) **[6mks]**

c) A large batch of items is to be tested by using double sampling inspection scheme specified by the following numbers $n_1 = 20,\ n_2 = 40,\ c_1 = 0,\ c_2 = c_3 = 2$

i. Obtain an expression for the probability of accepting a batch in which the true proportion of defective is θ **[5mks]**

ii. Obtain the value of this probability when $\theta = 0.05$ and $\theta = 0.1$ **[3mks]**

QUESTION 5: (20 Marks)

a) A company purchases large lots of items using a single sampling plan for which $n = 4$ and $c = 0$

i. Find the probability of acceptance of a lot in terms of proportion of defective items it contains. **[2mks]**

ii. What is the probability of

1. A lot containing 50% defective being accepted **[2mks]**
2. A lot containing 10% defective being rejected **[2mks]**

iii. Estimate the AQL (θ) corresponding to a producers risk of 5% and LTPD (θ) corresponding to consumer's risk of 10% **[3mks]**

iv. If rectification is agreed on, find the expression for the average outgoing quality (AOQ) in terms of the incoming quality. Find AOQ if $\theta = 0.05$ **[2mks]**

v. Calculate the average total inspection (ATI) of lots of size 100 of quality $\theta = 0.05$ **[3mks]**

b) i. Construction a sequential sampling plan from a Bernoulli population that following values $\theta_0 = 0.02, \theta_1 = 0.08, \alpha = 0.05$ and $\beta = 0.1$ **[3mks]**

ii. An inspector test 40 units from a large lot. Would he have come to a decision to reject or accept the lot if he found the 10^{th}, 18^{th}, and 23^{rd} unit defective. **[3mks]**