KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

FOURTH YEAR FIRST SEMESTER
SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN RENEWBLE ENERGY AND BIOFUELS TECHNOLOGY

COURSE CODE: IPT 422

COURSE TITLE: QUALITY RELIABILITY ENGINEERING

DURATION: 2 HOURS

DATE: 10/1/2022 **TIME: 8-10AM**

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **3** printed pages. Please Turn Over

QUESTION 1 (30 marks)

a. Define the following terms:
   i. Quality engineering (1 mark)
   ii. Reliability engineering (1 mark)
   iii. Quality planning (1 mark)
   iv. Failure rate (1 mark)
   v. Occurrence (1 mark)
b. State any five (5) dimensions of quality. (5 marks)
c. Describe the process of reliability management. (5 marks)
d. State any five (5) reasons why the control charts are popular. (5 marks)
e. State any five (5) major tools in the statistical process control toolbox. (5 marks)
f. Forty (40) components were tested for 2 weeks. Fifteen (15) of them failed in this time with an average failure time of 1.5 weeks. What is the mean time till failure assuming a constant failure rate? (5 marks)

QUESTION 2 (20 marks)

a. State any four (4) assumptions in process capability analysis. (4 marks)
b. State any four (4) conditions for maintainability requirements. (4 marks)
c. Explain any three (3) lot-by-lot acceptance sampling plans for attributes. (6 marks)
d. Define any three (3) different forms of the steady state availability. (6 marks)

QUESTION 3 (20 marks)

a. State the steps involved in the process capability analysis. (8 marks)
b. The percent defective of the incoming lots is 3%. An OC curve showed the probability of acceptance to be 0.515. Given a lot size of 3,000 and a sample of 120, what is the average outgoing quality in percent defective? (6 marks)
c. 10 components were tested. The components (not repairable) failed as follows: Component 1, 2, 3, 4, 5 failed after 80, 120, 130, 325, 520 hours. Find the failure rate and mean time till failure. (6 marks)

QUESTION 4 (20 marks)

A Company has two plant lines that produce the solution for production of biodiesel. Data from the second line appears in Table 1. When the process is in control, the pH of the solution varies according to a normal distribution with mean $\mu = 6.0$ and standard deviation $\sigma = 0.9$. The quality control plan calls for collecting samples of size three from batches produced each hour.

Sample	pH level		
1	7.2	7.4	7.4
2	6.9	6.6	6.5
3	6.2	6.3	6.3
4	6.8	6.4	6.5
5	6.5	6.6	6.7
6	6.8	6.8	6.8
7	6.2	6.3	6.4
8	5.6	5.7	5.9
9	4.9	5.8	5.6
10	6.4	6.0	4.4
11	6.9	5.3	6.2
12	5.5	5.9	5.9
13	5.3	5.1	5.2
14	6.2	6.7	6.5
15	4.9	4.7	4.8
16	6.4	6.1	7.0
17	6.3	5.8	6.0
18	4.9	5.0	5.1
19	5.5	5.7	5.3
20	5.3	5.2	5.4
21	5.8	5.8	5.6
22	5.8	5.6	5.7
23	4.8	4.7	4.6
24	4.8	4.9	4.8

Table 1

a. Calculate the sample means for each of the 24 samples. (6 marks)
b. Construct a $\bar{x}$ control chart for the pH samples from the second plant line. Include reference lines marking the center line and one, two, and three $\sigma/\sqrt{n}$ on either side of the center line. (10 marks)
c. Based on the control chart from (b), does the process appear to be in control? If not, which decision rule applies and what appears to be the problem? (4 marks)

QUESTION 5 (20 marks)

a. Explain any four (4) stages of quality control evolvement. (8 marks)
b. Explain any three (3) random sampling techniques. (6 marks)
d. Comment on the process in Fig. 1 and Fig. 2 in terms of statistical control and capability. (6 marks)