



# KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS  
2021 /2022 ACADEMIC YEAR**

**FOURTH YEAR FIRST SEMESTER  
MAIN EXAMINATIONS**

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

**COURSE CODE: REN 414**

**COURSE TITLE: QUALITY RELIABILITY ENGINEERING**

**DURATION: 2 HOURS**

**DATE: 16/05/2022**

**TIME: 2:00PM-4:00PM**

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**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



KIBU observes ZERO tolerance to examination cheating

**QUESTION 1 (30 marks)**

- a. Define the following terms:
  - i. Quality planning (1 mark)
  - ii. Failure (1 mark)
  - iii. Hazard (1 mark)
  - iv. Maintainability (1 mark)
  - v. Availability (1 mark)
- b. Explain any five (5) dimensions of Quality. (5 marks)
- c. Explain any five (5) reasons that make reliability to be important. (5 marks)
- d. State the steps in estimating process capability. (5 marks)
- e. State any five (5) situations where lot-to-lot acceptance sampling is used. (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. Differentiate between manufacturing quality and service quality giving four examples of each. (6 marks)
- b. Explain the four (4) components involved in quality system documentation. (4 marks)
- c. State any six (6) points of management in Deming Philosophy. (6 marks)
- d. Explain any four (4) stages of quality control evolution. (4 marks)

**QUESTION 3 (20 marks)**

- a. Explain any five (5) reasons for reliability engineering. (5 marks)
- b. Explain the Bathtub curve in terms of Phase, Failure Rate, Possible causes and possible improvement actions including a sketch. (10 marks)
- c. Ten (10) components were tested. The components (not repairable) failed as follows: Components 1, 2, 3, 4, and 5 failed after 70, 120, 135, 315, 520 hours respectively. Find the failure rate and mean time till failure. ( 5 marks)

**QUESTION 4 (20 marks)**

- a. State any four (4) objectives of maintainability. (4 marks)
- b. State any three (3) forms of the steady state availability including their formulas. (6 marks)
- c. State any five (5) reasons for the popularity of control charts. (5 marks)
- d. Six (6) oil pumps were tested with failure hours of 40, 36, 65, 95, 80 and 105.
  - i. What is the MTTF? (3 marks)
  - ii. Failure rate? (2 marks)

**QUESTION 5 (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.

Table 1: Samples and pH levels.

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

- Calculate the sample means for each of the 24 samples. (6 marks)
- 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)
- 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)