# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

**P.O. Box 972-60200 – Meru-Kenya.**
**Tel: +254(0) 799 529 958, +254(0) 799 529 959, +254 (0)712 524 293**
**Website: www.must.ac.ke Email: info@mucst.ac.ke**


**UNIVERSITY EXAMINATIONS 2024/2025**

FOUR YEAR FIRST SEMESTER EXAMINATION FOR DEGREE OF BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

**EMT 3404: QUALITY CONTROL AND PLANT MAINTANANCE**

**DATE: JANUARY 2025** **TIME: 2 HOURS**

**INSTRUCTIONS:** Answer Question ONE and any other TWO questions.

**QUESTION ONE (30 MARKS)**

a) Discuss the application how the following methods improves plant reliability;

i, Standby redundancy (2 marks)

ii, Use of fewer parts (2 marks)

b) Outline three types of maintenance under planned maintenance. (6 marks)

c) Describe the following terms as applied in reliability analysis;

i, Mean Time Between Maintenance (2 marks)

ii, Failure Rate (2 marks)

ii, Mean Time To Repair (2 marks)

d) The reliability of a system is significantly influenced by three components A, B and C. Components A and B are in parallel, while C is in series with the two. If the reliabilities of

A, B and C 0.6, 0.5 and 0.8 respectively, calculate the overall reliability of the system (5 marks)

e) i) Describe the term Achieved Availability in reference to equipment maintenance (2 marks)

ii, During the maintenance of a shaping machine, the Mean Time Before Maintenance (MTBM) and the Mean Active Maintenance time were recorded as 210 and 36 hours respectively. Determine the Achieved availability of the machine (4 marks)

f) Statistical Quality Control of products is a method of quality control. Explain three benefits achieved when applying this method in an organization (3 marks)

**QUESTION TWO (15MARKS)**

a) Describe the following terms as used in Plant Maintenance;

i. Inherent availability (2 mark)

ii. Achieved availability (2marks)

b) A lathe machine is found to have a Mean Time Before Failure MTBF of 130 hours and a Mean Time To Repair MTTR of 18 hours.

i. Calculate the Inherent availability for the Lathe machine. (3 marks)

ii. If the Inherent availability increased to 0.859 determine the required Mean Time To Repair (3 marks)

c) Describe the following diagnosis techniques used in machine condition monitoring

i. Magnetic particle inspection (2 marks)

ii. Electrical resistance (3 marks)

**QUESTION THREE(15MARKS)**

a) Outline Six advantages of statistical quality control over 100 percent inspect (6 marks)

b) Explain the following types of Quality control;

i) Process control (3 marks)

ii) Lot control (3 marks)

c) Describe Three applications of control charts in improvement of a process (3 marks)

**QUESTION FOUR (15MARKS)**

a) Describe the Statistical Quality Control in maintaining of product quality (3 marks)

b) Discuss the use of control charts in statistical quality control (2 marks)

c) Table 4 shows the performance data for a newly installed water pump in a water treatment facility.

i. Using the C-chart, determine the mean failure rate (4marks)

ii, Sketch the C- chart for the pump from the data (3marks)

iii, Determine the Mean Time Between Maintenance of the pump from the C-chart (3 marks)

Table 4 Q(c)

| **Month** | **No of Inspection** | **No of pump failure** |
|---|---|---|
| January | 300 | 25 |
| February | 300 | 30 |
| March | 300 | 34 |
| April | 300 | 40 |
| May | 300 | 45 |
| June | 300 | 35 |
| July | 300 | 40 |
| August | 300 | 30 |
| September | 300 | 21 |
| October | 300 | 50 |

**QUESTION FIVE(15MARKS)**

a) Outline TWO advantages and TWO disadvantages of Acceptance sampling (2 marks)

b) Distinguish between acceptance sampling by Attributes and by variables (4 marks)

c) (i) Using Operating Characteristic OC curves Illustrate the producer and customer risks as used in acceptance sampling (4 marks)

ii) An iron sheets manufacturing company supplies 800 sheet to a customer. The customer takes a sample of 120 sheets for inspection. The set condition for the customer is that maximum defective sheet should be less than 6 and the defective percentage should be a minimum of 0.1%. Using binomial distribution, determine the probability of acceptance of the iron sheets (5 marks)