NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

M Eng Manufacturing Systems and Operations Management/ M Eng Manufacturing Engineering and Operations Management

QUALITY SYSTEMS

TIE 6230

MAIN EXAMINATION

SEPTEMBER 2024

This examination paper consists of 4 pages

Time Allowed:	3 hours
Total Marks:	100
Special Requirements:	Statistical Tables, Graph paper
Examiner's Name:	Prof Eng. D Zimwara, Eng T R Chikowore

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer a total of **FIVE questions**. Answer ALL questions in SECTION A and at least one in SECTION B and SECTION C.

2. Each question carries 20 marks.

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SECTION A (Answer ALL Questions in this Section)

Question 1

a) Discuss and compare the following quality tools:
   i) Department Purpose Analysis
   ii) Acceptable Quality Level
   iii) Failure Mode and Effect Analysis   [10]

b) Students trying to register online for a course, Quality Systems, sometimes find that the course has been closed, or the course is not available. Prepare a cause-and-effect diagram for this problem and comment on it.   [10]

Question 2

a) Assess and interpret the process capability for a machine with the following process data:

   Upper specification limit (USL)   = 9.2mm
   Lower specification limit (LSL)   = 8.8mm
   Specification target   = 9.0mm
   Process standard deviation, σ = 0.08732
   Process mean, μ = 8.9mm

                                                                             [10]

b) Shipments of 1500 units of product assembly kits are received at a warehouse of an assembly plant. Random samples of 10 kits are checked, and the lot is rejected if more than two kits reveal non-conformance. Construct an Average Operating Characteristic Curve (OPC) and comment on your result.   [10]

SECTION B (Answer AT LEAST ONE Question in this Section)

Question 3

Discuss the role that Artificial Intelligence (AI) can play in the management of quality of manufactured products today and in the future.   [20]

Question 4

Discuss the challenges faced by Zimbabwean manufacturing companies in producing quality products.   [20]

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Question 5

A manufacturer of quartz watches uses inspection to screen defective watches before they are shipped. Watches rejected by the inspector are reset by the factory. If a sold watch turns out to perform outside the warranted +/- 5 s/month tolerance, the customer is entitled to a replacement. However, a replacement costs the customer $25.00 per watch in postage and inconvenience.

a) Determine the loss function for this situation. [4]

b) If the cost of setting a watch is $2.00 at the factory, verify that the inspector should use a tolerance of +/- 1.41 s/month. [4]

c) Explain why the inspector should not use the +/- 5 s/month limit. [2]

d) If the mass-produced watches submitted for inspection show an average deviation of +10 s/month from perfect performance, with a standard deviation 5 s/month, and if the factory produces 10 000 watches per month, determine the total monthly loss caused to society if the factory ships the watches uninspected. [5]

e) Suppose that the manufacturer uses a different production method that reduces the average deviation to 0 s/month while retaining the 5 s/month standard deviation, and then ships the watches uninspected, determine the monthly total loss to society. [5]

Question 6

a) Explain the three concepts of measurement. Use appropriate examples to aid your answer. [12]

b) Mean charts and Range charts are constructed differently but always used together to monitor and control a process variable. Using diagrams and examples explain why they are always used together and not separately to monitor and control a given process variable. [8]

END OF EXAMINATION

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- Nominal is best:
$$L(y) = k[\sigma^2 + (\mu - T)^2]$$

- Smaller the better:
$$L(y) = k\left[\sigma^2 + \mu^2\right]$$

- Larger the better:
$$L(y) = k\left(\frac{1}{\mu^2}\right)\left(1 + 3\frac{\sigma^2}{\mu^2}\right)$$

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