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

FIRST SEMESTER MAIN EXAMINATION

DECEMBER 2023

This examination paper consists of 3 pages

Time Allowed: **3 hours**

Total Marks: **100**

Special Requirements: **Statistical Tables, Graph paper**

Examiner's Name: **Prof Eng. D Zimwara**

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer a total of FIVE questions.
2. Each question carries 20 marks

Question 1

Organisations the world over are competing using quality to improve the global market share. Discuss [20]

Question 2

Quality assurance has changed from a reactionary mood to real time monitoring today. Discuss the advantages and disadvantage of this change [20]

Question 3

Discuss the current and future trends in quality management in manufacturing [20]

Question 4

What are the challenges faced by Zimbabwe manufacturing companies in producing quality products?

Question 5

a) A production manager at a light bulb plant has inspected the number of defective light bulbs in 20 random samples with 30 observations each. Table Q3 shows the numbers of defective light bulbs found in each sample.

Table Q5: Number of Defectives per Sample

Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of Defectives	5	1	3	2	3	3	2	0	3	1	1	4	2	6	1

Develop an appropriate control chart for monitoring the number of defectives. [12]

b) An assembly operation for trigger mechanisms of a semiautomatic spray gun produces a small percentage of defective mechanisms. Management must decide whether to continue the current practice of 100 % inspection or to replace defective mechanisms after final assembly when all guns are inspected. Replacement at final assembly costs $30.00 each while inspection of trigger assembly costs $12.00 per hour for labour and overheads.

i) Would 100 percent inspection during trigger assembly be justified if there are:
   a) 4 % defectives [3]
   b) 1 % defectives [3]
   c) At what point would management be indifferent between 100 percent inspection of triggers and only final inspection? [2]

Question 6

a) Product design is the prime activity in the process of realising a product. By making reference to a product or process of your choice discuss Taguchi's philosophy and methodology for designing quality into products and processes. [10]

b) T R & C Engineering is planning to buy a couple of thousand bolts to be used in their systems. The system requires highly reliable bolts. In case of a bolt failure, the system repair cost is estimated to be $15.00. Two companies that use different kinds of alloys in their products bid to supply the bolts. T R & C Engineering decides to go for destructive testing using 20 specimens. The criterion used for testing is ultimate tensile strength measured in kgf/mm^2. The test data for both products are given in Table Q4b. The lower specification limit is 11 kgf/mm^2, and the purchase quantity is 20 000 units. The unit costs of products A and B are $0.14 and $0.13, respectively. Advise T R & C Engineering about its purchasing decision. [10]

Table Q6b: Ultimate Tensile Strength Data

Product (bolt)	**Ultimate tensile strength (kgf/mm^2)**									
A	15.5	13.8	15.1	15.3	13.7	15.5	13.8	15.1	15.2	13.6
	14.2	14.1	14.9	14.8	15.5	14.2	14.5	14.6	14.4	15.4
B	15.5	10.8	15.1	16.3	13.7	10.5	13.8	15.1	12.2	17.6
	11.2	14.1	11.9	14.8	17.5	14.2	17.5	14.6	18.4	13.4

Question 7

a) Briefly describe the three concepts of measurement. Use appropriate examples to aid your answer. [9]

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

Upper specification limit (USL) = 110
Lower specification limit (LSL) = 50
Process standard deviation, σ = 10
Process mean, μ = 60

[4]

c) Analysis of the output of a process has suggested that the variability is non-random on several occasions recently. However, each time an investigation has not revealed any assignable causes. What are some of the possible explanations for not finding any causes? What should the manager do? [7]

END OF EXAMINATION