NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

BACHELOR OF SCIENCE HONOURS DEGREE IN APPLIED BIOLOGY AND BIOCHEMISTRY

PRINCIPLES OF QUALITY ASSURANCE (SBB2211)

Main Examination Paper

MARCH 2025

This examination paper consists of 4 pages

Time Allowed : 3 hours

Total Marks : 100

Special Requirements: Graph paper, calculator

Examiner's Name : MS J. B CHANGE & MR D NDEBELE

INSTRUCTIONS

1. Answer four **(4)** questions. Each question carries 25 marks.
2. Where a question contains subdivisions, the mark value for each subdivision is given in brackets.
3. Illustrate your answer where appropriate with large, clearly labelled diagrams.

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**25**
3.	**25**
4.	**25**
5.	**25**
6.	**25**
TOTAL	**100**

1. Write short notes on the following quality control tools:
   (a) Cause and effect diagram (5 marks)
   (b) Pareto charts (5 marks)
   (c) Control charts (5 marks)
   (d) Histograms (5 marks)
   (e) Scatter diagrams (5 marks)

2. (a) Briefly describe what is involved in a HACCP system. . (10 marks)

   (b) Outline in detail the requirements of ISO 9001 Certification of an organisation. (15 marks)

3. A project team is studying the downtime cost of a soft drink bottling line. Three months' worth of data analysis in thousands of dollars are shown in the table below:

Type of defect	**Number of defects**
Back pressure regulator	30
Jam copper head	6
Lost cooling	52
Valve replacement	8
Other	5

(a) Construct a Pareto diagram and comment on the action required to reduce downtime in this production line. (9 marks)

(b) Outline briefly, the elements that contribute to quality costs in a production process. (10 marks)

(c) Describe, with examples where necessary, three main categories of defects used within a quality system. (6 marks)

4.(a) Describe the 5 elements of ISO 14001:2015 (15 marks)

(b) Briefly discuss the following statement "Many organisations seek ISO 14000 as a marketing tool and not EMS..." (5 marks)

5.(a) Define and interpret the process capability index, Cpk, highlighting its significance in process control. (10 marks)

(b) A manufacturing company produces precision metal rods. The company wants to know the diameter of these rods to ensure consistent quality. They collect data by taking samples of five rods (n=5) every hour for 8 hours. The diameter of each rod is measured in millimetres. The data collected is shown in the following Table.

Constants (for n = 5), A2 = 0.577; D3 = 0; D4 = 2.114

Sample Number	Sample Diameter (mm)				
	1	2	3	4	5
1	9,98	10,02	9,95	10,05	10
2	10,03	9,97	10,01	10	9,99
3	10,01	9,98	10,03	10,02	9,96
4	9,95	10	9,99	10,01	10,05
5	10,04	9,96	9,98	10,02	9,99
6	9,98	10,03	10	9,97	10,01
7	10,02	9,99	10	10	9,97
8	10	10,02	10,1	10,05	10,15

(a) Calculate the overall average (X) and the average range (R). (4 marks)

(b) Calculate the control limits for the X-bar chart (UCL and LCL). (4 marks)

(c) Calculate the control limits for the R chart (UCL and LCL). (4 marks)

(d) Construct the X-bar and R charts. Plot the sample means and ranges. Clearly show the control limits and centre lines. (8 marks)

(e) Based on the control charts you produced, critically evaluate the manufacturing process and provide recommendations. (5 marks)

6. (a) Define acceptance sampling and explain its purpose in quality assurance. (4 marks)

   (b) Differentiate between single sampling, double sampling, and multiple sampling plans. (6 marks)

   (c) (i) Define the Operating Characteristic (OC) curve. Explain what it represents in the context of incoming inspection and batch acceptance. (2 marks)

   (ii) Discuss the key characteristics of an OC curve. Explain with examples, what information these characteristics provide about the performance and effectiveness of a sampling plan. (3 marks)

   (iii) Outline the impact on the OC curve of changing the Sample Size(n), the Acceptance Number(c) and the Batch Size (N). (4 marks)

   (d) A sampling plan is said to have an AQL of 0.6 % at 5 % producer's risk, and an LTDP of 4 % at 10 % consumer risk. Using this sampling plan, state the probability of accepting a batch containing

   (i) 0.6 % defectives. (3 marks)

   (ii) 4 % defectives. (3 marks)

END OF EXAMINATION