



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022**

COURSE NAME : INDUSTRIAL QUALITY CONTROL
COURSE CODE : BWB31403
PROGRAMME CODE : BWQ
EXAMINATION DATE : JULY 2022
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER ALL QUESTIONS.
2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**.

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

- Q1** (a) State the term of attributes in quality control. (4 marks)
- (b) A random sample of n units of product is selected, and let D be the number of units of product that are nonconforming, then D has a binomial distribution with parameters n and p . Explain the sample fraction nonconforming. (6 marks)
- (c) In a television manufacturing process, the sample fraction nonconforming is $p = 0.3$ for a sample size of 20. However, the manager argued that the sample fraction nonconforming has a higher value and suggested to the quality executive to reduce the value of the sample fraction nonconforming. As a quality executive, you are required to discuss the center line and control limits in the control chart that are being used. Based on the control limits, give **FIVE (5)** suggestions to response to the manager's argument. (15 marks)

Q2 In a production process, 20 samples of $n = 50$ units each were selected at one-hour intervals over a three-shift period in which the machine was in continuous operation. The data are shown in **Table Q2**.

Table Q2: Data for nonconforming units

Sample Number	Number of Nonconforming units	Sample Number	Number of Nonconforming units
1	19	11	29
2	19	12	18
3	16	13	27
4	24	14	28
5	25	15	10
6	38	16	28
7	13	17	25
8	41	18	14
9	5	19	19
10	18	20	42

- (a) Provide the sum of the number of nonconforming units. (2 marks)
- (b) Calculate the average of individual sample fractions nonconforming. (3 marks)
- (c) Determine the control limits for the control chart to be used. (5 marks)
- (d) Draw the control chart to visualize the data given in **Table Q2**. (8 marks)
- (e) Give your conclusion from the control chart in **Q2 (d)**. (7 marks)

- Q3** In a printed circuit board process, there are 22 successive samples of 100 printed circuit boards that give the total of 330 nonconformities. The observed average number of nonconformities in these sample of inspection units can be estimated. When no standard deviation is given, the control limits should be regarded as the trial control limits, and these samples are examined for lack of control in the usual Phase I analysis.
- (a) Estimate the average number of nonconformities. (2 marks)
 - (b) Provide the trial control limits for nonconformities. (7 marks)
 - (c) Suppose samples 4 and 18, which have 27 and 28 nonconformities, are outside the control limits. Exclude these two samples and revise the trial control limits. (10 marks)
 - (d) 20 new samples, each consists of one inspection unit with 100 boards, are subsequently collected for improving the process. A total of 290 nonconformities are noticed, where the maximum sample point and the minimum sample point are 19 and 10, respectively. Indicate if there have any lack of control. (6 marks)

- Q4** A supply chain enterprise monitors shipments of raw materials through a distribution network. Errors on the delivered material that are recorded in documentation are tracked each week. Given that there are 30 random selected shipments are examined every week and the errors are recorded. The data for samples in 10 weeks are shown in **Table Q4**.

Table Q4: Data on number of shipping errors

Week	Total Number of Errors
1	5
2	2
3	6
4	1
5	1
6	3
7	3
8	2
9	7
10	5

- (a) Set up a control chart for nonconformities per unit to monitor this process. (20 marks)
- (b) Calculate the probabilities of Type II error against the true mean number of nonconformities per unit. Use the mean of 1.1667 for the number of nonconformities per unit given by $x = 1, 2, 3$. (5 marks)

- END OF QUESTIONS -