UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	INDUSTRIAL QUALITY CONTROL
COURSE CODE	:	BWB 31403
PROGRAMME	:	3 BWQ / 3 BWA
EXAMINATION DATE	:	DECEMBER 2014 / JANUARY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS IN **SECTION A** 2. ANSWER **THREE** QUESTIONS IN **SECTION B**

THIS QUESTION PAPER CONSISTS OF **SEVEN** (7) PAGES

SECTION A

Q1 Explain any two dimensions of quality that are typically applicable in finance and banking industry.

(5 marks)

Q2 Quality planning and quality control and improvement are activities for effective management of quality. Distinguish between these two activities.

(5 marks)

Q3 State the first five steps in Crosby's step.

(5 marks)

Q4 Control charts for $\bar{X}$ and R are maintaned on the critical dimension of part produced by a welding process. A sample size of 7 was used. After 30 samples, the following sums were obtained.

$$\sum_{i=1}^{35} \bar{X}_i = 7800 \qquad \sum_{i=1}^{35} R_i = 1200$$

Suppose the critical dimension is normally distributed. Assuming thay both charts exhibit control and the specifications are 250 ± 35, estimate the fraction of nonconforming.

(5 marks)

Q5 Explain process capability ratio C_p. For the process capability ratio $C_p = 1$ with two-sided specifications, the process fallout (in defective part per million) is 2,700. What are the three assumptions used in that statement.

(5 marks)

Q6 Ten parts are measured three times by the same operator in gauge capability study. The following summaries were obtained, $\bar{\bar{X}} = 98.2$, $\bar{R} = 2.3$ and estimate of total variability is 4.717. Analyze the P/T ratio for this gauge (use k = 6), if the specifications on the part are 100 ± 15. Conclude on the adequacy of the gauge.

(5 marks)

Q7 Explain the advantage of CUSUM control chart and EWMA control chart over the Shewhart control chart? State the reason when and why EWMA chart is preferred over CUSUM control chart.

(5 marks)

Q8 Let x_i, $i=1,2,\ldots,k$ be independent random variable for i-th sample with mean μ and variance σ^2. The exponentially weighted moving average (EWMA) for the i-th sample is

$$z_i = \lambda x_i + (1-\lambda) z_{i-1}$$

where $i=1,2,\ldots,k$, $z_0 = \bar{x}$ and $0<\lambda<1$. The variance of z_i is $v(z_i) = \sigma^2 \left[\lambda/(2-\lambda)\right]\left[1-(1-\lambda)^{2i}\right]$. Derive the upper and lower three sigma control limits for EWMA control chart if $\mu=10$, $\sigma=12$ and $\lambda=0.2$ for $i=1$ and 2.

(5 marks)

SECTION B

Q1 The following Table Q1 gives the number of nonconforming blower motor in an electric hair dryer in samples of size 300.

Table Q1 Number of nonconforming motors

Sample Number	Number of Nonconforming Motors	Sample Number	Number of Nonconforming Motors
1	12	11	3
2	3	12	0
3	9	13	5
4	4	14	7
5	0	15	8
6	6	16	16
7	6	17	2
8	1	18	5
9	11	19	6
10	2	20	3

(a) State the sampling distribution of the number of nonconforming? What are the mean and variance of the fraction of nonconforming?

(3 marks)

(b) Construct a fraction nonconforming control chart with three-sigma control limits for the above data. Comment on the pattern of the plots.

(14 marks)

(c) Assume that assignable causes can be found for any out of control points. Determine the revised three-sigma control limits.

(3 marks)

Q2 A supply chain engineering group monitors shipments of materials through the company distribution network. Errors on either the delivered material or accompanying documentation are tracked on a weekly basis. 50 randomly selected shipments are examined and the errors recorded. Data for 20 weeks are shown in Table Q2.

Table Q2 Number of shipping errors

Sample Number	Total Number of Nonconformities	Sample Number	Total Number of Nonconformities
1	2	11	8
2	3	12	2
3	7	13	4
4	1	14	3
5	0	15	4
6	4	16	1
7	10	17	2
8	4	18	3
9	5	19	7
10	12	20	4

(a) State the sampling distribution of the number of nonconformities? What are the mean and variance of the defect of nonconformities?

(3 marks)

(b) Construct an average number of nonconformities per unit control chart with three-sigma control limits for the above data.

(14 marks)

(c) Assume that assignable causes can be found for any out of control points. Determine the revised three-sigma control limits.

(3 marks)

Q3 In a chemical plant involved in making paint for household use, the viscosity of the liquid has to be maintained. Table Q3 shows the viscosity values for 25 samples. The process target is $\mu_0 = 15.0$, $h = 5$ and $k = \frac{1}{2}$.

Table Q3 Viscosity values

Sample	Viscosity	Sample	Viscosity
1	16.2	14	16.7
2	13.8	15	15.9
3	17.0	16	14.6
4	15.8	17	16.6
5	13.5	18	18.4
6	14.7	19	15.2
7	14.0	20	14.6
8	14.8	21	17.2
9	13.2	22	16.1
10	16.8	23	14.4
11	14.9	24	17.0
12	13.0	25	15.5
13	16.5		

(a) Explain the value of k? What is the reasonable value for h?

(3 marks)

(b) Construct a tabular CUSUM and CUSUM status charts for this process.

(14 marks)

(c) Is the process under statistical control? Justify your answer.

(3 marks)

Q4 A machine is used to fill cans with motor oil additive. A single sample can is selected every hour and the weight of the can is obtained. Since the filling process is automated, it has very stable process mean and variability. Long experience indicates that $\mu = 8.02$ oz and $\sigma = 0.05$ oz. The individual observations for 24 hours of operations are shown below in Table Q4.

Table Q4 Weight of cans

Sample	Weight	Sample	Weight
1	8.00	14	8.05
2	8.01	15	8.04
3	8.02	16	8.03
4	8.01	17	8.05
5	8.00	18	8.06
6	8.01	19	8.04
7	8.06	20	8.05
8	8.07	21	8.06
9	8.01	22	8.04
10	8.04	23	8.02
11	8.02	24	8.03
12	8.01	25	8.05

(a) What are the mean and variance of a moving average control chart with $w = 5$?
(3 marks)

(b) Construct a moving average control chart for these data.
(14 marks)

(c) Does the process appear in control? Give your comment.
(3 marks)

- END OF QUESTION -