

---

# UNIVERSITI SAINS MALAYSIA

Second Semester Examination  
Academic Session 2010/2011

April/May 2011

## EBB 342/3 – Control & Management Quality *[Kawalan & Pengurusan Mutu]*

Duration : 3 hours  
*[Masa : 3 jam]*

---

Please ensure that this examination paper contains TWELVE printed pages before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi DUA BELAS muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

This paper consists of SEVEN questions.

*[Kertas soalan ini mengandungi TUJUH soalan.]*

**Instruction:** Answer FIVE questions. If candidate answers more than five questions only the first five questions answered in the answer script would be examined.

**[Arahan:** Jawab LIMA soalan. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]

The answers to all questions must start on a new page.

*[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]*

You may answer a question either in Bahasa Malaysia or in English.

*[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

In the event of any discrepancies, the English version must be used.

*[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]*

1. [a] Explain the following terms used in production practice by giving appropriate examples:
- (i) Accuracy
  - (ii) Repeatability
  - (iii) Reproducibility
  - (iv) Stability

*Terangkan istilah berikut yang diamalkan dalam pengeluaran dengan menggunakan contoh yang sesuai:*

- (i) Kejituan
- (ii) Kebolehulangan
- (iii) Kebolehasilan
- (iv) Kestabilan

(50 marks/markah)

- [b] What is the relationship between customer and quality? Answer this question based on an example.

*Apakah perhubungan antara pelanggan dan mutu? Jawab soalan ini berdasarkan satu contoh yang sesuai.*

(50 marks/markah)

2. [a] According to Phillip B. Corsby, "Quality is free. It's not a gift, but it is free. What costs money are the un-quality things - all the actions that involve not doing jobs right the first time." Do you agree with this statement? Answer needs to be supported by strong justifications and examples.

*Menurut Phillip B. Corsby, "Mutu adalah percuma. Ia bukan sesuatu hadiah tetapi ia adalah percuma. Yang melibatkan kos ialah sesuatu yang tidak bermutu – segala tindakan melibatkan kerja yang dilakukan dengan tidak sempurna pada permulaannya." Adakah anda setuju kenyataan ini? Jawapan perlu disokong oleh justifikasi dan contoh yang sesuai.*

(50 marks/markah)

...3/-

---

- [b] What is the relationship between quality, productivity, costs, cycle time, and value.

*Apakah hubungan antara mutu, produktiviti, kos, kitaran masa dan nilai.*

(50 marks/markah)

3. [a] Six sigma concept can be used to improve quality of a product or an organization. Explain the concept.

*Konsep "Six Sigma" boleh digunakan untuk mempertingkatkan mutu sesuatu produk atau organisasi. Terangkan konsep tersebut.*

(20 marks/markah)

- [b] An Engineer evaluates incoming raw materials using the following single sampling plan:  $N = 8000$ ,  $n = 50$ , and  $c = 1$ . Construct an operating characteristic (OC) curve and an average outgoing quality (AOQ) curves using at least 7 points. Determine:

- (i) the average outgoing quality limit (AOQL) value,
- (ii) the percent of average outgoing quality (AOQ),
- (iii) the probability of acceptance for 1.0% nonconforming unit, and
- (iv) the acceptance quality level (AQL) value for producer's risk = 0.05.

*Seorang jurutera menilai bahan-bahan mentah yang dibeli dengan menggunakan pelan pensampelan berikut:  $N = 8000$ ,  $n = 50$ , dan  $c = 1$ . Plotkan lengkok ciri-ciri Pengendalian (OC) dan satu lengkok Mutu Purata Pengeluaran (AOQ) dengan menggunakan sekurang-kurangnya 7 titik. Tentukan:*

- (i) nilai Mutu Purata Terhad Pengeluaran (AOQL),
- (ii) peratus bagi Mutu Purata Pengeluaran (AOQ),
- (iii) penerimaan kebarangkalian bagi 1.0% unit tak sesuai, dan
- (iv) tahap Mutu Kebolehterimaan (AQL) bagi risiko pengeluar = 0.05.

(50 marks/markah)

...4/-

- [c] Using ANSI/ASQ Z1.4, a QC inspector needs to determine the single sampling plans for the following information:

*Dengan menggunakan ANSI/ASQ Z1.4, seorang pemeriksa QC perlu menentukan pelan-pelan pensampelan tunggal seperti berikut:*

|     | Inspection Level /<br><i>Tahap Pemeriksaan</i> | Inspection /<br><i>Pemeriksaan</i>  | AQL /<br><i>Tahap Mutu<br/>Kebolehterimaan</i> | Lot Size /<br><i>Saiz Lot</i> |
|-----|--|-------------------------------------|--|-------------------------------|
| (a) | II   | Tightened /<br><i>Diperketatkan</i> | 1.0  | 5000                          |
| (b) | I  | Normal /<br><i>Normal</i>           | 0.10   | 20                            |

Explain the meaning of the sampling plan determined if in (a) 5 nonconforming units are found in the sample and (b) 0 nonconforming units are found in the sample.

*Terangkan maksud pelan-pelan pensampelan yang diperoleh, jika (a) mempunyai 5 unit tak sesuai ditemui dalam sampel dan (b) mempunyai 0 unit tak sesuai di dalam sampel.*

(30 marks/markah)

4. [a] Weight of alumina balls (in gram) from two (2) manufacturing processes are listed in Table 1.
- Compute the average ( $\bar{X}$ ) and standard deviation ( $s$ ).
  - Which process provides better quality? Explain briefly.

*Berat bebola alumina (dalam gram) yang dihasilkan oleh dua (2) proses pembuatan disenaraikan dalam Jadual 1.*

- Kira purata ( $\bar{X}$ ) dan sisihan piawai ( $s$ ).*
- Proses yang mana memberikan mutu terbaik? Jelaskan secara ringkas.*

...5/-

Table 1: Weight of alumina balls

*Jadual 1: Berat bebola alumina*

| <b>Item No. /<br/>No. Barang</b> | <b>Process A /<br/>Proses A</b> | <b>Process B /<br/>Proses B</b> |
|----------------------------------|---------------------------------|---------------------------------|
| 1                                | 4.0                             | 5.0                             |
| 2                                | 5.3                             | 6.8                             |
| 3                                | 7.5                             | 7.9                             |
| 4                                | 9.2                             | 8.0                             |
| 5                                | 9.0                             | 9.8                             |
| 6                                | 10.5                            | 11.5                            |

(40 marks/markah)

- [b] Table 2 shows a tabulation of causes of ball bond lifting during soldering process.
- (i) Use the data to draw a Pareto diagram with cumulative line.
  - (ii) Propose an action plan that should be taken in order to improve the quality.

*Jadual 2 menunjukkan tabulasi penyebab ikatan bebola terkopek semasa pematerian.*

- (i) *Gunakan data tersebut untuk melukis gambarajah Pareto yang dilengkapi dengan garis kumulatif.*
- (ii) *Cadangkan suatu pelan tindakan yang perlu diambil untuk meningkatkan mutu.*

Table 2: Ball bond lifting soldering process

*Jadual 2: Ikatan bebola terkopek semasa proses pematerian*

| <b>Ball lifting cause / Penyebab bebola terkopek</b>           | <b>Frequency / Frekuensi</b> |
|--|------------------------------|
| Bonder set-up issues / Persediaan pengikat                     | 20                           |
| Unetched glass on bond pad / Kaca tak terpunar atas pad ikatan | 11                           |
| Foreign contamination on bond pad / Bendasing atas pad ikatan  | 9                            |
| Excessive probe damage / Kerosakan kuar berlebihan             | 4                            |
| Silicon dust on bond pad / Habuk silikon pada pad ikatan       | 3                            |
| Corrosion / Hakisan  | 2                            |
| Others / Lain-lain   | 1                            |

(60 marks/markah)

5. [a] The data in Table 3 shows the oxide thickness (in nanometer) on silicon wafer from selected subgroup of three thermal oxidation furnace.
- (i) Construct a control chart for these data. Use zone boundaries method.
  - (ii) Is the process in control? If not, which group does the out of control behavior occur? Explain.

*Data dalam Jadual 3 menunjukkan ketebalan oksida (dalam nanometer) di atas wafer silikon bagi subkumpulan terpilih daripada tiga relau pengoksidaan terma.*

- (i) *Bina satu carta kawalan bagi data ini. Gunakan kaedah sempadan-sempadan zon.*
- (ii) *Adakah proses ini terkawal? Jika tidak, pada kumpulan yang mana terjadi perilaku yang tak terkawal? Jelaskan.*

Table 3: Oxide thickness on silicon wafer

*Jadual 3: Ketebalan oksida di atas wafer silikon*

| <b>Group /<br/>Kumpulan</b> | <b>Thickness in nm / Ketebalan dalam nm</b> |          |          |
|-----------------------------|---|----------|----------|
|                             | <b>1</b>                                    | <b>2</b> | <b>3</b> |
| 1                           | 5.2   | 7.4      | 4.9      |
| 2                           | 5.6   | 3.7      | 3.3      |
| 3                           | 5.5   | 7.3      | 6.2      |
| 4                           | 4.4   | 10.0     | 7.4      |
| 5                           | 3.7   | 4.6      | 4.8      |
| 6                           | 8.3   | 6.9      | 10.1     |
| 7                           | 4.7   | 3.6      | 4.3      |
| 8                           | 6.8   | 7.5      | 6.4      |
| 9                           | 10.7  | 3.7      | 11.1     |
| 10                          | 5.7   | 4.0      | 9.0      |
| 11                          | 3.6   | 3.9      | 5.2      |
| 12                          | 4.6   | 2.7      | 8.3      |
| 13                          | 7.9   | 8.2      | 9.8      |
| 14                          | 7.1   | 4.3      | 8.2      |
| 15                          | 8.1   | 5.8      | 6.9      |
| 16                          | 6.7   | 8.9      | 7.0      |
| 17                          | 3.5   | 10.3     | 12.2     |
| 18                          | 6.9   | 5.1      | 3.2      |
| 19                          | 3.2   | 9.0      | 4.1      |
| 20                          | 8.1   | 4.4      | 3.2      |

(60 marks/markah)

...8/-

- [b] Figure 1 shows a process variability observed at certain time interval.
- (i) Discuss the process quality by comparing Figure 1(a) and 1(b).
  - (ii) Prepare the suitable action plan to reduce the variation of both processes.

*Rajah 1 menunjukkan ketakseregaman suatu proses yang telah diamati pada jangka masa tertentu.*

- (i) *Bincang mutu proses dengan membandingkan Rajah 1(a) dan 1(b).*
- (ii) *Sediakan pelan tindakan yang sesuai untuk mengurangkan ketakseregaman pada kedua-dua proses.*

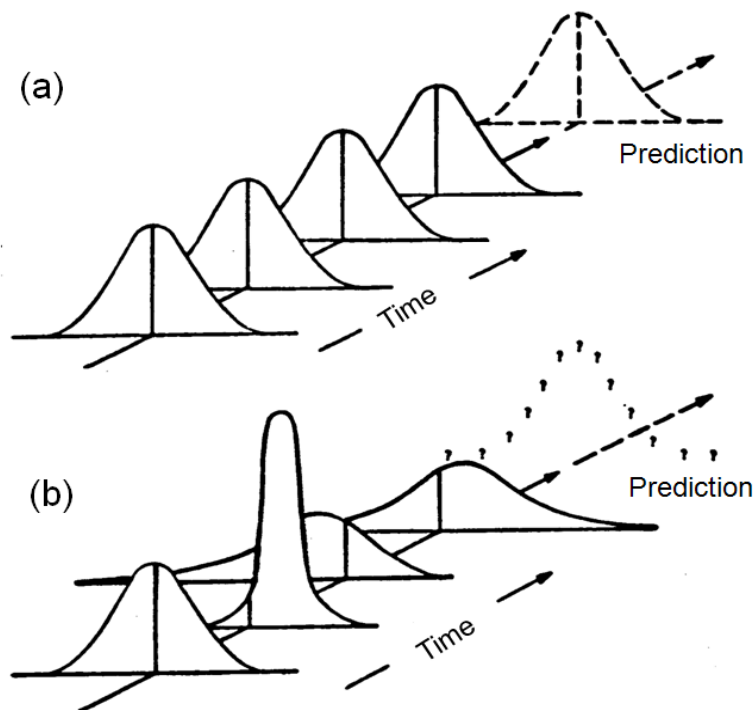


Figure 1: Process variability observed at certain time interval

*Rajah 1: Ketakseregaman suatu proses diamati pada jangka masa tertentu*

(40 marks/markah)



6. [a] A process was monitored to make sure that it is running normally while samples were taken to develop a  $c$ -chart. Ten random subgroup samples of the same size were taken, and the number of defects that were observed in each subgroup was noted as:

*Suatu proses telah diamati untuk memastikan ianya berjalan lancar dimana sampel telah diambil untuk membina carta-c. Sepuluh sampel subkumpulan dengan saiz yang sama telah diambil secara rambang dan bilangan produk cacat telah diamati bagi setiap subkumpulan seperti berikut:*

|                                    |    |    |    |    |    |    |    |    |    |    |
|------------------------------------|----|----|----|----|----|----|----|----|----|----|
| Subgroup /<br><i>Subkumpulan</i>   | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| No. defects /<br><i>Bil. cacat</i> | 32 | 29 | 30 | 30 | 31 | 29 | 30 | 29 | 29 | 31 |

What are the upper control limit (UCL) and lower control limit (LCL) for the  $c$ -chart with a 99% confidence?

*Tentukan had kawalan atas (UCL) dan had kawalan bawah (LCL) untuk carta-c dengan 99% keyakinan.*

(40 marks/markah)

- [b] Table 4 shows data of the count of nonconformities on selected 20 subgroup of electronic products. Each subgroup a sample of 50 products is drawn from the total of all produced products.
- (i) Determine the centerline and control limits (CL, UCL, and LCL) for  $u$ -chart construction.
  - (ii) Draw the  $u$ - chart.
  - (iii) Are there any indications of a lack of control? Assume the out of control data (if any) due to the special causes, and then revise the chart.

...10/-

Jadual 4 menunjukkan data bilangan produk elektronik yang tidak menepati piawaian daripada 20 subkumpulan terpilih. Setiap subkumpulan meliputi 50 sampel yang telah diambil daripada kumpulan produk yang dihasilkan.

- (i) Tentukan garis tengah dan had kawalan (CL, UCL, LCL) bagi pembinaan carta-u.
- (ii) Lukis carta-u.
- (iii) Adakah sebarang tanda-tanda proses tak terkawal? Anggap data proses tak terkawal (jika ada) disebabkan oleh "kes khas", dan ubahsuai carta.

Table 4: Count of nonconformities on selected 20 subgroup of electronic products

Jadual 4: Bilangan produk elektronik yang tidak menepati piawaian daripada 20 subkumpulan terpilih

| Subgroup /<br>Subkumpulan | Sample size /<br>Saiz sampel | Count of nonconformities /<br>Bilangan yang tak menepati piawai |
|---------------------------|------------------------------|---|
| 1                         | 50                           | 5   |
| 2                         | 50                           | 2   |
| 3                         | 50                           | 12  |
| 4                         | 50                           | 5   |
| 5                         | 50                           | 9   |
| 6                         | 50                           | 6   |
| 7                         | 50                           | 4   |
| 8                         | 50                           | 10  |
| 9                         | 50                           | 3   |
| 10                        | 50                           | 12  |
| 11                        | 50                           | 4   |
| 12                        | 50                           | 8   |
| 13                        | 50                           | 3   |
| 14                        | 50                           | 15  |
| 15                        | 50                           | 5   |
| 16                        | 50                           | 4   |
| 17                        | 50                           | 8   |
| 18                        | 50                           | 4   |
| 19                        | 50                           | 2   |
| 20                        | 50                           | 10  |

(60 marks/markah)

...11/-

7. [a] By giving examples, explain the meaning of reliability, durability, and robustness.

*Dengan menggunakan contoh-contoh yang sesuai, terangkan maksud keboleharapan, durability, dan ketahananlasakan.*

(30 markah)

- [b] Sketch, label, and explain a life-history curve.

*Lakar, label, dan terangkan lengkung sejarah jangka hayat.*

(20 marks/markah)

- [c] A group of 10 silicon wafers located in a box has 3 cracked units. What is probability of drawing 2 cracked unit in a random sample of 5?

*Sekumpulan 10 wafer silikon terdiri daripada 3 unit yang retak diletakkan dalam sebuah kotak. Apakah kebarangkalian untuk menarik 2 unit retak dalam 5 sampel rambang?*

(20 marks/markah)

- [d] A consumer protection agency wants to study the life expectancy of a new bulb lamp. A sample of 12 bulbs were randomly selected from the lot. Achieved lifetime in hour are: 2160, 2010, 2800, 2950, 1950, 2400, 1800, 2670, 2020, 2110, 2590 and 1960.
- (i) Calculate the mean, modal life expectancy, range and standard deviation for these data.
  - (ii) Is a run chart an appropriate display for these data? Explain why or why not, and if so, construct a run chart.

*Suatu agen perlindungan pengguna ingin mengkaji jangka hayat mentol lampu. Sampel terdiri daripada 12 mentol telah dipilih secara rambang daripada lot. Jangka hayat yang tercapai ialah 2160, 2010, 2800, 2950, 1950, 2400, 1800, 2670, 2020, 2110, 2590 dan 1960.*

- (i) Kira purata, mod, julat dan sisihan piawai bagi data ini.*
- (ii) Adakah sebuah “run chart” sesuai untuk menunjukkan data ini? Jelaskan mengapa, atau mengapa tidak, dan jika ya, bina satu “run chart” bagi data ini.*

(30 marks/markah)