UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2016/2017 Academic Session

June 2017

MSG 362 – QUALITY CONTROL
[KAWALAN MUTU]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of NINE pages of printed material before you begin the examination.

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

Instructions: Answer **FOUR** (4) questions.

*[**Arahan:** Jawab **semua empat** (4) soalan.]*

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

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

QUESTION 1

(a) Write short notes with examples on the topics below:

(i) Reducing **process variation** in companies

(ii) Using **TQM model** for managing quality

(iii) Adopting **KAIZEN** in process improvement

(iv) Identifying **bottlenecks** in process flow analysis

(v) Performing **process capability analysis** in a stable process

[100 marks]

SOALAN 1

(a) Tulis nota-nota pendek dengan contoh tentang topik-topik di bawah:

*(i) Mengurangkan **variasi proses** dalam syarikat*

*(ii) Menggunakan **model TQM** untuk mengurus kualiti*

*(iii) Melaksanakan **KAIZEN** untuk penambahbaikan proses*

*(iv) Mengenalpasti **halangan** dalam analisis aliran proses*

*(vi) Mengendalikan **analisis keupayaan proses** dalam proses stabil.*

[100 markah]

QUESTION 2

(a) ***The Magnificent Seven*** is well known in Quality Control field. What is ***The Magnificent Seven***? Why is it magnificent?

[20 marks]

(b) How can ***The Magnificent Seven*** be used in the problem-solving process and in our personal lives? Provide two examples with illustrations.

[30 marks]

(c) **Graphs** provide a visual description of the information in a process. Show and explain how graphs can be used in visualizing a process for ***stability*** and ***capability***.

[20 marks]

(d) **Process Flow analysis** is crucial in identifying ***bottlenecks*** and ***potential sources of variation and problems.*** Perform a process flow analysis for the most important process in your life. What is the root cause of the most critical problem in your process? What are the corrective actions you can take to improve your process? (*Hint*: Use a combination of SPC tools)

[30 marks]

SOALAN 2

*(a) '**The Magnificent Seven**' terkenal dalam bidang Kawalan Kualiti. Apakah itu '**The Magnificent Seven**'? Mengapakah ia sangat baik?*

[20 markah]

*(b) Bagaimanakah '**The Magnificent Seven**' digunakan dalam proses penyelesaianmasalah dan dalam kehidupan peribadi kita? Berikan dua contoh dengan ilustrasi.*

[30 markah]

*(c) **Graf** memberi penerangan visual maklumat dalam proses. Tunjukkan dan terangkan bagaimana graf boleh digunakan dalam menggambarkan proses untuk **kestabilan** dan **keupayaan**.*

[20 markah]

*(d) **Analisis Aliran Proses** adalah penting dalam mengenal pasti **halangan** dan **sumber potensi perubahan dan masalah**. Laksanakan analisis aliran proses untuk proses yang paling penting dalam hidup anda. Apakah sebab punca kepada masalah yang paling kritikal dalam proses anda? Apakah tindakan pembetulan yang boleh diambil untuk memperbaiki proses anda? (Petunjuk: Gunakan gabungan alat SPC.)*

[30 markah]

QUESTION 3

(a) One measure of software quality is the error rate per 1,000 lines of code (Dunn, 1988). With the abbreviation 'K' for the word 'thousand', a block of 1,000 lines of computer code is often abbreviated as KLOC (K lines of code). The data in **Table 1** show the defects per KLOC obtained from daily test logs in a software company.

Table 1. Number of errors per 1,000 lines of code (KLOC)

Day	Nonconformities (Errors) per KLOC
1	6
2	7
3	7
4	6
5	8
6	6
7	5
8	8
9	1
10	6
11	2
12	5
13	5
14	4
15	3
16	3
17	2
18	0
19	0
20	1
21	2
22	5
23	1
24	7
25	7
26	1
27	5
28	5
29	8
30	8

Use the data in **Table 1** to construct a c-chart and interpret the chart. What do you say about the control chart's pattern? What is your conclusion?

[40 marks]

(b) CUSUM charts have many applications in chemical industries, in which numerous chemical characteristics must be maintained close to specified target levels. To ensure the chemical purity of a commercial organic chemical, measurements of the level of a certain intermediate chemical material are taken every 4 hours. Data from 22 samples are shown in **Table 2**.

Table 2. Chemical level from 22 samples

Sample number	Level
1	15.3
2	15.7
3	14.4
4	14.0
5	15.2
6	15.8
7	16.7
8	16.6
9	15.9
10	17.4
11	15.7
12	15.9
13	14.7
14	15.2
15	14.6
16	13.7
17	12.9
18	13.2
19	14.1
20	14.2
21	13.8
22	14.6

(i) Given that the target chemical level is 15 and that the process standard deviation is known to be about 1, construct a CUSUM chart for the data in **Table 2**. Use $k = 0.5\sigma$ and $h = 5.0\sigma$.

(ii) Construct an individuals chart of the data and compare its performance to the CUSUM chart in part (i).

(iii) Using a parameter value of $\lambda = 0.20$, construct an EWMA chart of this data and compare its performance to the CUSUM chart in part (i).

(iv) What can you conclude about the chemical process from the results in parts (i) to (iii)?

[60 marks]

SOALAN 3

(a) *Satu ukuran kualiti perisian adalah kadar kesilapan setiap 1000 baris kod (Dunn, 1988). Dengan singkatan 'K' untuk perkataan 'ribu', blok 1000 baris kod komputer sering disingkatkan sebagai KLOC (baris K kod). Data dalam* ***Jadual 1*** *menunjukkan kecacatan setiap KLOC diperolehi dari log ujian setiap hari di sebuah syarikat perisian.*

Jadual 1. *Bilangan kesilapan setiap 1000 baris kod (KLOC)*

Hari	*Ketakakuran (kesilapan) bagi setiap KLOC*
1	*6*
2	*7*
3	*7*
4	*6*
5	*8*
6	*6*
7	*5*
8	*8*
9	*1*
10	*6*
11	*2*
12	*5*
13	*5*
14	*4*
15	*3*
16	*3*
17	*2*
18	*0*
19	*0*
20	*1*
21	*2*
22	*5*
23	*1*
24	*7*
25	*7*
26	*1*
27	*5*
28	*5*
29	*8*
30	*8*

Gunakan data dalam ***Jadual 1*** *bagi membina carta-c dan tafsirkan carta tersebut. Apa yang dapat anda katakan tentang corak carta kawalan tersebut? Apakah kesimpulan anda?*

[40 markah]

(b) *Carta CUSUM mempunyai banyak aplikasi dalam industri kimia, di mana banyak ciri-ciri kimia mesti dikekalkan hampir ke tahap sasaran yang ditetapkan. Untuk memastikan kesucian kimia bahan kimia organik komersial, pengukuran tahap bahan kimia perantaraan tertentu diambil setiap 4 jam. Data daripada 22 sampel ditunjukkan dalam* ***Jadual 2****.*

Jadual 2*. Tahap bahan kimia dari 22 sampel*

Nombor sampel	*Tahap*
1	*15.3*
2	*15.7*
3	*14.4*
4	*14.0*
5	*15.2*
6	*15.8*
7	*16.7*
8	*16.6*
9	*15.9*
10	*17.4*
11	*15.7*
12	*15.9*
13	*14.7*
14	*15.2*
15	*14.6*
16	*13.7*
17	*12.9*
18	*13.2*
19	*14.1*
20	*14.2*
21	*13.8*
22	*14.6*

(i) *Diberi bahawa tahap kimia sasaran adalah 15 dan proses sisihan piawai diketahui kira-kira 1, bina carta CUSUM bagi data dalam* ***Jadual 2****. Gunakan* $k = 0.5\sigma$ *dan* $h = 5.0\sigma$.

(ii) *Bina carta individu bagi data ini dan bandingkan prestasi carta CUSUM di bahagian (i).*

(iii) *Dengan menggunakan nilai parameter* $\lambda = 0.20$, *bina carta EWMA bagi data ini dan bandingkan prestasi carta CUSUM di bahagian (i).*

(iv) *Apakah kesimpulan mengenai proses kimia dari hasil di bahagian-bahagian (i) hingga (iii)?*

[60 markah]

QUESTION 4

(a) The production of integrated circuits by etching them onto silicon wafers requires silicon wafers of consistent thickness. Low Electronics Sdn. Bhd. encountered quality problems in silicon wafer Line B. The data collected from Line B are given in **Table 3**. Low's customer has raised questions about whether or not the process is capable of producing wafers within their specifications of 0.2500 mm ± 0.0050. What and how should Low's process engineers do to satisfy the customer's requirements? Interpret the process engineers' findings.

Table 3. Thickness of silicon wafers

Subgroup	Wafer 1	Wafer 2	Wafer 3	Wafer 4
1	0.2500	0.2510	0.2490	0.2500
2	0.2510	0.2490	0.2490	0.2520
3	0.2510	0.2490	0.2510	0.2480
4	0.2490	0.2470	0.2520	0.2480
5	0.2500	0.2470	0.2500	0.2520
6	0.2510	0.2520	0.2490	0.2510
7	0.2510	0.2480	0.2500	0.2500
8	0.2500	0.2490	0.2490	0.2520
9	0.2500	0.2470	0.2500	0.2510
10	0.2480	0.2480	0.2510	0.2530
11	0.2500	0.2500	0.2500	0.2530
12	0.2510	0.2490	0.2510	0.2540
13	0.2500	0.2470	0.2500	0.2510
14	0.2500	0.2500	0.2490	0.2520
15	0.2500	0.2470	0.2500	0.2510

[60 marks]

(b) A bedsheet supplier and a large hotel system have decided to evaluate units in lots of 1,000 using an AQL of 1.0% with a probability of rejection of 0.10. Determine sampling plans for $c =$ 0, 1, 2 and 4. How would you select the most appropriate plan?

[40 marks]

SOALAN 4

(a) Pengeluaran litar bersepadu oleh punaran mereka ke wafer silikon memerlukan wafer silikon yang ketebalannya konsisten. Low Electronik Sdn. Bhd. menghadapi masalah kualiti dalam silikon wafer Baris B. Data yang dikumpul dari Baris B diberikan dalam ***Jadual 3****. Pelanggan Low telah menimbulkan persoalan tentang sama ada proses ini mampu menghasilkan wafer dalam spesifikasi mereka yang hamper 0.500 mm ± 0.0050. Apakah dan bagaimanakah jurutera proses Low perlu lakukan untuk memenuhi keperluan pelanggan? Tafsir penemuan jurutera proses.*

Jadual 3*. Ketebalan wafer silikon*

Subkumpulan	*Wafer 1*	*Wafer 2*	*Wafer 3*	*Wafer 4*
1	*0.2500*	*0.2510*	*0.2490*	*0.2500*
2	*0.2510*	*0.2490*	*0.2490*	*0.2520*
3	*0.2510*	*0.2490*	*0.2510*	*0.2480*
4	*0.2490*	*0.2470*	*0.2520*	*0.2480*
5	*0.2500*	*0.2470*	*0.2500*	*0.2520*
6	*0.2510*	*0.2520*	*0.2490*	*0.2510*
7	*0.2510*	*0.2480*	*0.2500*	*0.2500*
8	*0.2500*	*0.2490*	*0.2490*	*0.2520*
9	*0.2500*	*0.2470*	*0.2500*	*0.2510*
10	*0.2480*	*0.2480*	*0.2510*	*0.2530*
11	*0.2500*	*0.2500*	*0.2500*	*0.2530*
12	*0.2510*	*0.2490*	*0.2510*	*0.2540*
13	*0.2500*	*0.2470*	*0.2500*	*0.2510*
14	*0.2500*	*0.2500*	*0.2490*	*0.2520*
15	*0.2500*	*0.2470*	*0.2500*	*0.2510*

[60 markah]

(b) Seorang pembekal cadar dan sebuah sistem hotel besar telah membuat keputusan untuk menilai unit dalam saiz lot 1000 dengan menggunakan AQL 1.0% dan kebarangkalian penolakan 0.10. Tentukan pelan pensampelan untuk $c = 0$, 1, 2 dan 4. Bagaimanakah anda memilih pelan yang paling sesuai?

[40 markah]

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