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# UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua  
Sidang Akademik 2008/2009

April - Mei 2009

## **EEM 421 – KAEDAH-KAEDAH KUALITI**

Masa: 3 jam

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Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEBELAS** muka surat dan **DUA** muka surat **LAMPIRAN** yang bercetak sebelum anda memulakan peperiksaan ini.

Kertas soalan ini mengandungi **ENAM** soalan.

Jawab **LIMA** soalan.

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Agihan markah bagi setiap soalan diberikan di sudut sebelah kanan soalan berkenaan.

Jawab semua soalan dalam bahasa Malaysia atau bahasa Inggeris atau kombinasi kedua-duanya.

1. (a) Apakah perbezaan di antara produktiviti dan kualiti?  
*What is the difference between productivity and quality?*  
(4 marks)
- (b) Prinsip-prinsip kualiti telah berkembang dari masa semasa. Terangkan prinsip-prinsip kualiti berikut:  
*Quality principles evolved over time. Describe the following quality principles:*
- (i) Pertukangan  
*Artisan* (2 marks)
  - (ii) Pemeriksaan  
*Inspection* (2 marks)
  - (iii) Pengawalan kualiti  
*Quality control* (2 marks)
  - (iv) Pengawalan kualiti berperangkaan  
*Statistical quality control* (2 marks)
  - (v) Pengawalan pemproses berperangkaan  
*Statistical process control* (3 marks)
  - (vi) Pengurusan kualiti berkeseluruhan  
*Total quality management* (2 marks)
  - (vii) Perbaikan berpanjangan  
*Continuous improvement* (3 marks)

2. Andaikan anda bekerja di sebuah syarikat pengeluar televisyen. Sejak dua minggu yang lepas, pihak syarikat anda sering mendapat aduan daripada pengguna berkenaan model terbaru televisyen yang dikeluarkan. Ramai pengguna mengadu gambar yang dipamerkan oleh televisyen adalah kabur. Pengguna juga mengatakan gambar akan dicemari hingar dedenyut semasa hujan lebat. Pihak pengurusan telah mengarahkan anda, seorang jurutera kualiti, untuk menangani aduan ini. Anda telah bercadang untuk menggunakan kitaran PDSA. Senaraikan kesemua SEPULUH (10) langkah yang terlibat dalam kitaran PDSA. Nyatakan kepentingan setiap langkah tersebut. Bagaimanakah langkah-langkah ini anda laksanakan? Senarai dan jelaskan dengan ringkas alat-alat kualiti yang terlibat dalam langkah-langkah yang berkaitan.

*Assume that you are working with a company that produces television. Since two weeks ago, your company receives complaints from customers on the latest television model. Many customers complained that the pictures displayed on the television are blur. Customers also informed that the picture is normally corrupted with impulse noise during heavy rain. Your management has asked you, a quality engineer, to resolve these complaints. You have decided to use PDSA cycle. Describe all TEN (10) steps involved in PDSA cycle. Describe the importance of each steps? How will you execute these steps? List down and whenever necessary, briefly explain the quality tools that are involved in each steps.*

(20 marks)

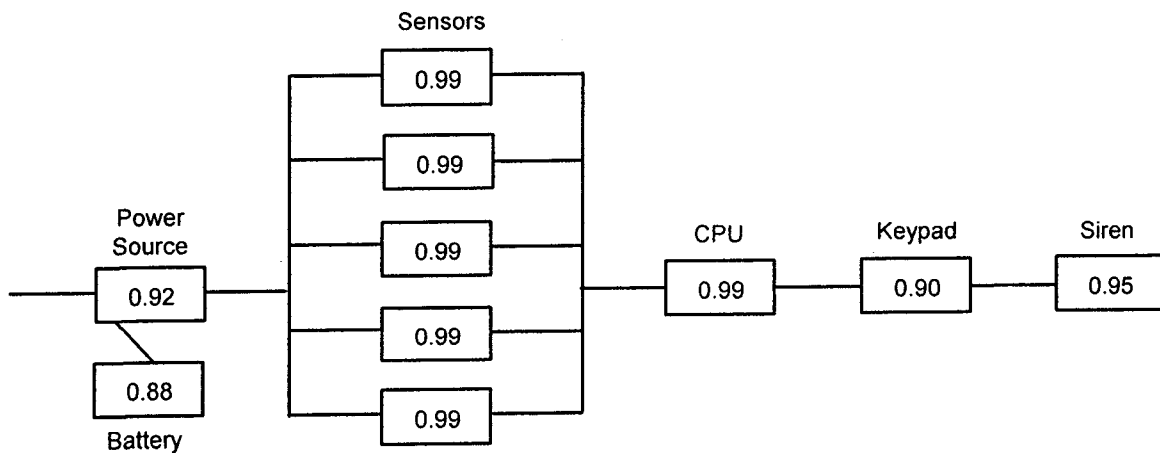
3. (a) Jelaskan perbezaan di antara jaminan mutu dan kawalan mutu.  
*Describe the difference between quality assurance and quality control.*

(4 marks)

- (b) (i) Dalam usaha untuk menghalang pecah masuk oleh pencuri, sebuah syarikat telah bercadang untuk memasang sistem penggera seperti yang ditunjukkan dalam Rajah 1. Kirakan kebolehharapan keseluruhan sistem tersebut. Jelaskan kenapa sistem selari mempunyai pengharapan yang lebih baik daripada sistem bersiri.

*In an attempt to discourage thieves' break-in, a company has decided to install an alarm system as shown in Figure 1. Calculate the overall system reliability. Explain why a parallel system is more reliable than a system in series.*

(4 marks)



Gambarajah Kebolehharapan Suatu Sistem Penggera  
*Reliability diagram of an Alarm System*

Rajah 1  
Figure 1

- (c) (i) Jelaskan secara ringkas empat jenis kos kualiti  
*Describe briefly the four types of quality cost.*
- (ii) Sebuah syarikat pembuatan komponen kereta mendapati kos kualiti seperti yang ditunjukkan pada Jadual 1. Nilai yang diberi adalah peratus kos keseluruhan sebuah komponen. Plotkan carta kos kualiti dan berikan analisis aliran kos tersebut.

*A car component manufacturing company has incurred the following quality costs as shown in Table 1. With the aid of a graph, analyse the trends of these costs. Values are given in percentage of total cost of lamp. Plot the quality costs chart and analyse the trends of the cost.*

Jadual 1  
Table 1

KOS COSTS				
Year Tahun	Prevention Penahanan	Appraisal Penilaian	Internal Failure Kegagalan dalaman	External Failure Kegagalan Luaran
1	1.2	3.6	4.7	5.7
2	1.6	3.5	4.3	4.6
3	2.2	3.8	4.0	3.8
4	2.5	2.7	3.5	2.2
5	3.0	2.0	2.8	0.9

(12 marks)

4. (a) Ungkapan berikut adalah berkaitan dengan pengukuran. Jelaskan ungkapan tersebut dengan bantuan gambarajah.

*The following terms are related to measurement. Explain the terms with the aid of a diagram:*

(i) Ketepatan  
*Accuracy*

(ii) Keperşisan  
*Precision*

(4 marks)

- (b) Berikan TIGA (3) sebab kenapa sesebuah syarikat perlu memilih untuk menggunakan QFD dalam bisnes mereka.

*Give THREE (3) reasons why a company should choose to use Quality Function Deployment (QFD) techniques in their business.*

(6 marks)

- (c) Kriteria kualiti sebuah mesin pencetak adalah panjang shaf. Jadual 2 memberikan purata dan julat untuk 21 sub kumpulan yang dikutip pada suatu jangka masa tertentu. Saiz sub kumpulan adalah 5. Maklumat tambahan yang diberi termasuk komen berkaitan dengan proses tersebut.

*A quality characteristic of a printing machine is the length of the shaft. Table 2 gives the average and range for the length of the shaft for 21 subgroups collected over a certain period. The subgroup size is 5. Additional recorded information includes the comments pertaining to the process.*

Jadual 2  
Table 2

SUBGROUP NUMBER	$\bar{X}$	$R$	Comments
1	11.99	0.08	
2	12.00	0.07	
3	11.99	0.04	
4	11.99	0.06	
5	12.02	0.03	
6	11.99	0.03	
7	12.00	0.05	
8	12.01	0.04	
9	11.99	0.06	
10	12.01	0.08	
11	11.97	0.05	
12	11.94	0.04	New operator
13	11.95	0.05	Bump at setting
14	11.95	0.06	Bump at setting
15	11.97	0.07	
16	11.98	0.04	
17	11.99	0.05	
18	12.01	0.03	
19	12.00	0.06	
20	12.01	0.03	
21	12.00	0.04	

- (i) Dapatkan garis tengah cubaan dan had kawalan cubaan untuk carta  $\bar{X}$  dan  $R$ , dan plotkan dicarta kawalan. Nyatakan titik di luar kawalan

*Determine the trial central lines and control limits for the  $\bar{X}$  and the  $R$  charts, and plot them on a control chart. Indicate the out of control points.*

- (ii) Lajur komen dalam Jadual 2 mengenalpasti sebab yang di untukkan. Sebab yang dinyatakan diandaikan sebagai sebab kebetulan. Oleh itu, kemaskini garis tengah cubaan dan had kawalan cubaan.

*The assignable causes have been determined and noted in the comment column of Table 2. Those that are not noted are assumed to be due to chance cause. Hence, revise the central line and control limits.*

(10 marks)

5. (a) Dalam Rekabentuk Ujikaji apakah maksud ungkapan berikut?  
*In Design Of Experiments (DOE) what does the following terms mean?*

- |       |                               |           |
|-------|-------------------------------|-----------|
| (i)   | Faktor<br><i>Factor</i>       | (3 marks) |
| (ii)  | Peringkat<br><i>Level</i>     | (3 marks) |
| (iii) | Replikasi<br><i>Replicate</i> | (3 marks) |
| (iv)  | Ulangan<br><i>Repetition</i>  | (3 marks) |

- (b) Jika Jadual 3 di bawah adalah perwakilan pengembangan Rekabentuk Faktor  $2^3$ , apakah rekabentuk matrik yang baru untuk pecahan faktor separuh; dengan mengisi lajur D.

*If this Table 3 below is the expanded representation of a  $2^3$  Factorial Design; what is the new design matrix for half fractional factorial by filling up Column D?*

(8 marks)



Jadual 3  
Table 3

A	B	C	AXB	AXC	BXC	AXBXC
1	1	1	1	1	1	1
-1	1	1	-1	-1	1	-1
1	-1	1	-1	1	-1	-1
-1	-1	1	1	-1	-1	1
1	1	-1	1	-1	-1	-1
-1	1	-1	-1	1	-1	1
1	-1	-1	-1	-1	1	1
-1	-1	-1	1	1	1	-1

A	B	C	D
1	1	1	
-1	1	1	
1	-1	1	
-1	-1	1	
1	1	-1	
-1	1	-1	
1	-1	-1	
-1	-1	-1	

6. Seorang Jurutera ingin menjalankan suatu kajian untuk rintangan (R0501) dari Synton-Tech Corporation (S) dan B2B Freezone (B) pada Papan Litar Cetak. Jurutera tersebut telah mengambil sebanyak 30 sampel rintangan dari setiap pembekal dan menjalankan ujikaji di atas Pelan PCB. Keputusan ujikaji menggunakan "Statgraphic Software" adalah seperti ditunjukkan di Jadual 4. Seterusnya isi tempat kosong seperti yang diberi pada Kertas Jawapan yang disertakan pada muka surat 11.

*An Engineer would like to perform a study on resistor (R0501) from Synton – Tech Corporation (S) and B2B Freezone (B) on the designed Printed Circuit Board (PCB). The engineer had taken a sample of 30 pieces of resistors from each suppliers' and ran the experiment on the PCB layout.*

*Results from the experiment using Statgraphic Software is shown in Table 4. Hence fill in the blanks as given in Attached Answer Sheet on page 11.*

(20 marks)

... 10/-

**Tests for Normality for Synton**

Computed Chi-Square goodness-of-fit statistic = 14.0  
P-Value = 0.300708  
Shapiro-Wilks W statistic = 0.969682  
P-Value = 0.575956  
Z score for skewness = 0.207516  
P-Value = 0.835603  
Z score for kurtosis = 0.967661  
P-Value = 0.333212

**Tests for Normality for B2B Freezone**

Computed Chi-Square goodness-of-fit statistic = 14.0  
P-Value = 0.300708  
Shapiro-Wilks W statistic = 0.970065  
P-Value = 0.586068  
Z score for skewness = 0.884435  
P-Value = 0.37646  
Z score for kurtosis = 0.611344  
P-Value = 0.540969

**Comparison of Means (assuming equal variances)**

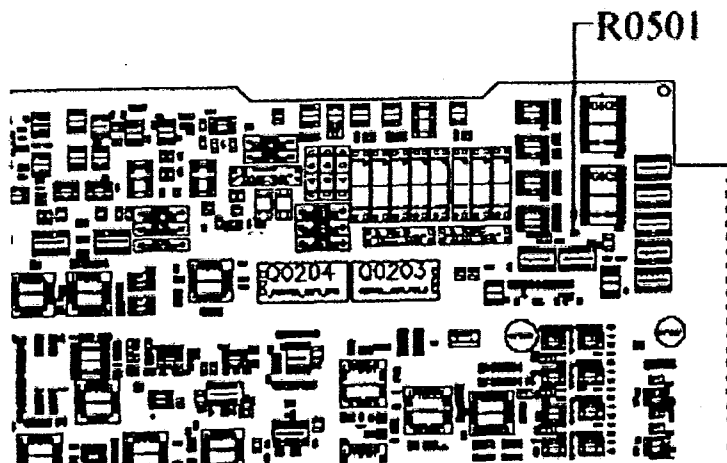
95.0% confidence interval for mean of Synton:  
6.92833 +/- 0.331474 [6.59686,7.25981]  
95.0% confidence interval for mean of B2B Freezone:  
6.60567 +/- 0.22193 [6.38374,6.8276]  
95.0% confidence interval for the difference between the means  
assuming equal variances: 0.322667 +/- 0.390422 [-0.0677552,0.713088]  
t test to compare means  
Null hypothesis: mean1 = mean2  
Alt. hypothesis: mean1 NE mean2  
assuming equal variances: t = 1.65434 P-value = 0.103462

**Comparison of Means (not assuming equal variances)**

95.0% confidence interval for mean of Synton:  
6.92833 +/- 0.331474 [6.59686,7.25981]  
95.0% confidence interval for mean of B2B Freezone:  
6.60567 +/- 0.22193 [6.38374,6.8276]  
95.0% confidence interval for the difference between the means  
not assuming equal variances: 0.322667 +/- 0.391632 [-0.0689652,0.714299]  
t test to compare means  
Null hypothesis: mean1 = mean2

**Alt. hypothesis: mean1 NE mean2**

not assuming equal variances: t = 1.65434 P-value = 0.104244



**Variance Check**

Cochran's C test: 0.690481 P-Value = 0.0344795  
Bartlett's test: 1.08156 P-Value = 0.034484  
Hartley's test: 2.23082  
Levene's test: 1.81821 P-Value = 0.182769

**Comparison of Medians**

Median of sample 1: 7.01  
Median of sample 2: 6.59  
Mann-Whitney (Wilcoxon) W test to compare medians  
Null hypothesis: median1 = median2  
Alt. hypothesis: median1 NE median2  
Average rank of sample 1: 34.75  
Average rank of sample 2: 26.25  
W = 322.5 P-value = 0.0600863

**ATTACHMENT:**

(Please remove and attached together with your answer script)

**ANSWER SHEET FOR QUESTION 6**

**Hypothesis Statement:**

Ho : Synton - Tech Corporation (S) and B2B Freezone (B) resistors are similar.

HA : \_\_\_\_\_

**Normality Test:**

- Synton (S) \_\_\_\_\_ (p = \_\_\_\_\_),

- B2B Freezone (B) \_\_\_\_\_ (p = \_\_\_\_\_)

Since data \_\_\_\_\_,

**Variance Check**

Data Not Normal Or Normal; -Ho :  $\sigma_S = \sigma_B$  ; HA:  $\sigma_S \neq \sigma_B$

\_\_\_\_\_ Test, p = \_\_\_\_\_, therefore  $\sigma$  between Synton (S) and B2B Freezone (B) resistors is \_\_\_\_\_.

**Test for** \_\_\_\_\_ ; \_\_\_\_\_

-Ho :  $s = B$ ; HA:  $s \neq B$

-P = \_\_\_\_\_, therefore \_\_\_\_\_ is \_\_\_\_\_ significantly different for Resistor value.

**Results:**

Since \_\_\_\_\_ Test and \_\_\_\_\_ show \_\_\_\_\_ difference; thus Accept \_\_\_\_\_.

**Conclusions:**

Useful formulae:

*Formula penting:*

$$\bar{\bar{X}} = \frac{\sum_{i=1}^m \bar{X}_i}{m}$$

$$\bar{R} = \frac{\sum_{i=1}^m R_i}{m}$$

$$UCL_{\bar{X}} = \bar{\bar{X}} + A_2 \bar{R}$$

$$LCL_{\bar{X}} = \bar{\bar{X}} - A_2 \bar{R}$$

$$UCL_R = D_4 \bar{R}$$

$$LCL_R = D_3 \bar{R}$$

For the revised chart

$$\bar{\bar{X}}_{new} = \frac{\sum \bar{X} - \bar{X}_d}{m - m_d}$$

$$\bar{R}_{new} = \frac{\sum R - R_d}{m - m_d}$$

$$UCL_{\bar{X}} = \bar{\bar{X}}_{new} + A \sigma_0$$

$$UCL_R = D_2 \sigma_0$$

$$\text{with } \sigma_0 = \frac{\bar{R}_{new}}{d_2}$$

$$LCL_{\bar{X}} = \bar{\bar{X}}_{new} - A \sigma_0$$

$$LCL_R = D_1 \sigma_0$$

$\bar{\bar{X}}$  = average of the subgroup averages

$\bar{X}_i$  = average of the *i*th group

*m* = number of subgroups

$\bar{R}$  = average of the ranges

$R_i$  = individual range values for the sample

$\bar{X}_d$  = discarded subgroup averages

$m_d$  = number of discarded subgroups

$R_d$  = discarded subgroup ranges

The factors *A, A<sub>2</sub>, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>, D<sub>4</sub>, d<sub>2</sub>* for computing the central lines and 3σ control limits for  $\bar{X}$  and the *R* control charts is given in Appendix II

Factors for Computing Central Lines and 3 $\sigma$  Control Limits for  $\bar{x}$ , s, and R Charts

Observations In Sample, n	Chart for Averages			Chart for Ranges						Chart for Standard Deviations					
	Factors for Control Limits			Factor for Central Line						Factors for Control Limits					
	A	A <sub>2</sub>	A <sub>3</sub>	d <sub>2</sub>	d <sub>3</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	e <sub>2</sub>	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>	
2	2.121	1.880	2.659	1.128	0.853	0	3.686	0	3.267	0.7979	0	3.267	0	2.606	
3	1.732	1.023	1.954	1.693	0.888	0	4.358	0	2.574	0.8862	0	2.568	0	2.276	
4	1.500	0.729	1.628	2.059	0.880	0	4.698	0	2.282	0.9213	0	2.266	0	2.088	
5	1.342	0.577	1.427	2.326	0.864	0	4.918	0	2.114	0.9400	0	2.089	0	1.964	
6	1.225	0.483	1.287	2.534	0.848	0	5.078	0	2.004	0.9515	0.030	1.970	0.029	1.874	
7	1.134	0.419	1.182	2.704	0.833	0.204	5.204	0.076	1.924	0.9594	0.118	1.882	0.113	1.806	
8	1.061	0.373	1.099	2.847	0.820	0.388	5.306	0.136	1.864	0.9650	0.185	1.815	0.179	1.751	
9	1.000	0.337	1.032	2.970	0.808	0.547	5.393	0.184	1.816	0.9693	0.239	1.761	0.232	1.707	
10	0.949	0.308	0.975	3.078	0.797	0.687	5.469	0.223	1.777	0.9727	0.284	1.716	0.276	1.669	
11	0.905	0.285	0.927	3.173	0.787	0.811	5.535	0.256	1.744	0.9754	0.321	1.679	0.313	1.637	
12	0.866	0.266	0.886	3.258	0.778	0.922	5.594	0.283	1.717	0.9776	0.354	1.646	0.346	1.610	
13	0.832	0.249	0.850	3.336	0.770	1.025	5.647	0.307	1.693	0.9794	0.382	1.618	0.374	1.585	
14	0.802	0.235	0.817	3.407	0.763	1.118	5.696	0.328	1.672	0.9810	0.406	1.594	0.399	1.563	
15	0.775	0.223	0.789	3.472	0.756	1.203	5.741	0.347	1.653	0.9823	0.428	1.572	0.421	1.544	
16	0.750	0.212	0.763	3.532	0.750	1.282	5.782	0.363	1.637	0.9835	0.448	1.552	0.440	1.526	
17	0.728	0.203	0.739	3.588	0.744	1.356	5.820	0.378	1.622	0.9845	0.466	1.534	0.458	1.511	
18	0.707	0.194	0.718	3.640	0.739	1.424	5.856	0.391	1.608	0.9854	0.482	1.518	0.475	1.496	
19	0.688	0.187	0.698	3.689	0.734	1.487	5.891	0.403	1.597	0.9862	0.497	1.503	0.490	1.483	
20	0.671	0.180	0.680	3.735	0.729	1.549	5.921	0.415	1.585	0.9869	0.510	1.490	0.504	1.470	