

LAMPIRAN D3



PENYEMAKAN KERTAS SOALAN PEPERIKSAAN
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I/We have checked the typed copies of the Examination Paper stated below :

Kod Kursus : EBB 300/2 Tajuk Kursus : Statistik Kejuruteraan
Course Code Course Title
Engineering Statistics

Jangka Masa Peperiksaan : 2 Jam Bilangan Muka Surat Bertaip : 28 Muka Surat Bilangan Soalan Yang Perlu Dijawab : 4 Soalan
Duration of Examination Hours Number of typed pages Pages Number of questions required to be answered Questions

Soalan-soalan dijawab atas : Questions to be answered in : Sila (✓) Please (✓)	BUKU JAWAPAN Answer Book	OMR OMR Form	JAWAB DALAM KERTAS SOALAN Answer In Question Paper
	✓		

DENGAN INI DISAHKAN BAHAWA KERTAS SOALAN PEPERIKSAAN INI ADALAH TERATUR, BETUL DAN SEDIA UNTUK DICETAK.

Certified that this question paper is in order, correct and ready for printing.

Nama Pemeriksa : Sivakumar Tandatangan : [Signature] Tarikh : 26-10-2016
Name of Examiner(s) Huruf Besar SY Pung In Block Capitals Signature Date 1/11/2016

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UNIVERSITI SAINS MALAYSIA

First Semester Examination
2016/2017 Academic Session

December 2016 / January 2017

EBB 300/2 – Engineering Statistics [Statistik Kejuruteraan]

Duration : 2 hours
[Masa : 2 jam]

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

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

This paper consists of SIX questions. THREE questions in PART A and THREE questions in PART B.

[Kertas soalan ini mengandungi ENAM soalan. TIGA soalan di BAHAGIAN A dan TIGA soalan di BAHAGIAN B.]

Instruction: Answer **FOUR** questions. Answer **TWO** questions from PART A and **TWO** questions from PART B. If a candidate answers more than five questions only the first five questions answered in the answer script would be examined.

Arahan: Jawab **EMPAT** soalan. Jawab **DUA** soalan dari BAHAGIAN A dan **DUA** soalan dari BAHAGIAN B. Jika calon menjawab lebih daripada empat soalan hanya empat 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 in the examination questions, the English version shall be used.

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

PART A / BAHAGIAN A

1. [a] The pull-off force for connectors are measured in a laboratory. The results of 15 specimens are 241, 203, 201, 238, 210, 175, 190, 252, 194, 220, 183, 195, 194, 235 and 209 J.

Daya putus bagi penyambung telah diukur di dalam makmal. Keputusan bagi 15 spesimen adalah 241, 203, 201, 238, 210, 175, 190, 252, 194, 220, 183, 195, 194, 235 dan 209 J.

- (i) Rank the data in ascending order

Susunkan data tersebut dalam turutan menaik.

(5 marks/markah)

- (i) Calculate the mean, 1st quartile, median, 3rd quartile, lower whisker and upper whisker. Identify the outlier(s) if there is any.

Kirakan mean, sukuan pertama, median, sukuan ke-3, sesungut bawahan dan sesungut atasan. Tentukan titik luar jika ada.

(60 marks/markah)

- (ii) Sketch the box and whisker diagram.

Lakarkan rajah kotak dan sesungut.

(10 marks/markah)

- [b] A graphical summary of the shear strengths of 25 spot welds in a titanium alloy is shown in Figure 1. Is the data normal distributed? Justify your answer.

Ringkasan grafik bagi kekuatan ricihan untuk 25 titik kimpalan aloi titanium ditunjukkan dalam Rajah 1. Adakah data ini tertabur secara normal? Justifikasikan jawapan anda.

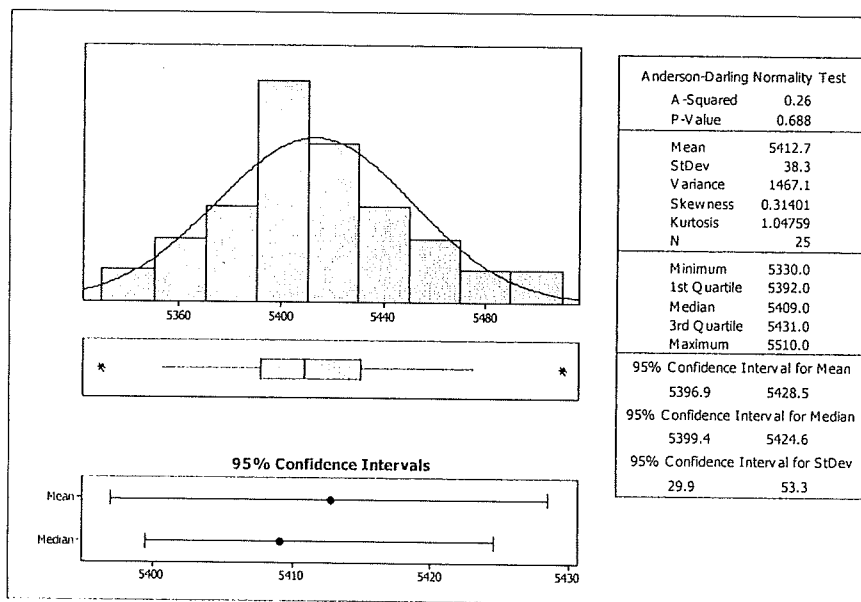


Figure 1. A graphical summary of shear strength of titanium alloy

Rajah 1. Ringkasan grafik bagi kekuatan ricihan aloi titanium

(25 marks/markah)

2. [a] A standard normal distribution is commonly used in statistic.
 (i) List 3 characteristics of a standard normal distribution.

Taburan normal piawai biasanya digunakan dalam statistik.

- (i) *Senaraikan 3 ciri bagi taburan normal piawai.*

(15 marks/markah)

- (ii) What is the value of standard deviation and mean for a standard normal distribution?

Apakah nilai sisihan piawai dan mean bagi sebuah taburan normal piawai?

(10 marks/markah)

- (iii) State the proportion of a standard normal distribution (in %) in the range of $\mu \pm \sigma$, $\mu \pm 2\sigma$ and $\mu \pm 3\sigma$.

Nyatakan pecahan bagi sebuah taburan normal piawai (dalam %) dalam julat $\mu \pm \sigma$, $\mu \pm 2\sigma$ and $\mu \pm 3\sigma$.

(15 marks/markah)

- [b] The diameter of ball bearings produced by a factory is normal distributed with population mean of 2.505 cm and standard deviation of 0.008 cm. The customer specification for the diameter of ball bearing is in the range of 2.49 to 2.51 cm. What is the probability (in %) of the ball bearings will meet the specification?

Diameter gelas bebola yang dihasilkan oleh sebuah kilang adalah tertabur secara normal dengan mean populasi 2.505 sm dan sisihan piawai 0.008 sm. Spesifikasi pelanggan bagi diameter gelas bebola adalah dalam julat 2.49 to 2.51 sm. Apakah kebarangkalian (dalam %) bagi gelas bebola yang akan memenuhi spesifikasi ini?

(30 marks/markah)

- [c] The nominal shear strength (kN) of 15 samples are 580, 400, 428, 825, 850, 875, 920, 550, 575, 750, 636, 360, 590, 735 and 950. Construct a 95% confident interval for the mean shear strength.

Kekuatan ricihan nominal (kN) bagi 15 sampel adalah 580, 400, 428, 825, 850, 875, 920, 550, 575, 750, 636, 360, 590, 735 dan 950. Binakan selang keyakinan 95% bagi mean kekuatan ricihan ini.

(30 marks/markah)

3. [a] The cut-on wavelength (μm) of 10 units of sensor chips assemblies are 6.06, 6.16, 6.57, 6.98, 6.17, 6.17, 6.93, 6.73, 6.87 and 6.76. Perform a hypothesis test at $\alpha = 0.05$. Is there evidence that the mean of cut-on wavelength is not $6.50 \mu\text{m}$?

Jarak gelombang "cut-on" (μm) bagi 10 unit pemasangan chip penerima adalah 6.06, 6.16, 6.57, 6.98, 6.17, 6.17, 6.93, 6.73, 6.87 dan 6.76. Lakukan ujian hipotesis pada $\alpha = 0.05$. Adakah bukti yang menunjukkan bahawa mean bagi jarak gelombang "cut-on" ini bukan $6.50 \mu\text{m}$?

(35 marks/markah)

- [b] A process engineer is interested in reducing the drying time of a primer paint. Two types of formulations of the paints are tested. It is known that the standard deviation of drying time (population) is 8 minutes. Ten specimens are painted with formulation 1 and another ten specimens are painted with formulation 2. The two sample average drying time are $\bar{X}_1 = 121$ minutes and $\bar{X}_2 = 112$ minutes, respectively. What conclusion can the process engineer draw about the effectiveness of the new formulation, using $\sigma = 0.05$? (Hint: hypothesis test on the different in means, variance known)

Seorang jurutera proses berminat untuk mengurangkan masa pengeringan bagi sejenis cat primer. Sisihan piawai bagi masa pengeringan (populasi) adalah 8 minit. Sepuluh spesimen telah dicat dengan formulasi 1 dan sepuluh lagi spesimen telah dicat dengan formulasi 2. Tempoh pengeringan kedua-dua sampel adalah $\bar{X}_1 = 121$ minutes dan $\bar{X}_2 = 112$ minit. Apakah kesimpulan yang boleh dibuat oleh jurutera proses ini mengenai keberkesanan formulasi yang baru, dengan $\sigma = 0.05$? (Petunjuk: ujian hipotesis pada perbezaan dalam mean, varian diketahui)

(40 marks/markah)

- [c] Consider the following ANOVA table for an experiment;

Pertimbangkan jadual ANOVA bagi satu eksperimen;

Source	DF	SS	MS	F
Factor	?	117.4	39.1	?
Error	16	407.5	?	
Total	19	524.9		

- (i) Fill in the missing information in the ANOVA table.

Isikan maklumat yang hilang di dalam jadual ANOVA.

(15 marks/markah)

- (ii) How many levels of the factor were used in this experiment?

Berapakah aras faktor yang telah digunakan dalam eksperimen ini?

(5 marks/markah)

- (iii) How many replicates did the experiment used?

Berapakah ulangan yang telah digunakan dalam eksperimen ini?

(5 marks/markah)

PART B / BAHAGIAN B:

4. [a] The evaluation of a flame retardant was conducted by a PhD student at two different laboratories on three different materials with the following results:

Penilaian perencat nyalaan api telah dijalankan oleh seorang pelajar PhD di dua makmal yang berbeza untuk tiga bahan yang berbeza dengan keputusan berikut:

Table 1: Evaluation Of A Flame Retardant

Jadual 1: Penilaian Perencat Nyalaan

	Materials (B)		
Laboratory (A)	1	2	3
1	4.1 , 3.9, 4.3	3.1 , 2.8, 3.3	3.5 , 3.2,3.6
2	2.7 , 3.1,2.6	1.9 , 2.2, 2.3	2.7 , 2.3, 2.5

Table 2: Total to calculate Sums of Squares				
Jadual 2: Jumlah untuk mengira jumlah kuasa dua				
Material (B)				
Laboratory	1	2	3	Total (A)
1	12.3	9.2	10.3	$Y_{1.} = 31.8$
2	8.4	6.4	7.5	$Y_{2.} = 22.3$
Total (B)	$Y_{.1} = 20.7$	$Y_{.2} = 15.6$	$Y_{.3} = 17.8$	$Y_{..} = 54.1$
There are n = 18 observation If given $CF = \frac{(54.1)^2}{18} = 162.6006$			$Total\ SS = (4.1^2 + 3.9^2 + \dots + 2.5^2) - CF$ $= 170.53 - 162.6006 = 7.9294$	
$SS(A) = \frac{(31.8^2 + 22.3^2)}{9} - CF$ $= 167.6144 - 162.6006 = 5.0139$			$SS(B) = \frac{(20.7^2 + 15.6^2 + 17.8^2)}{6} - CF$ $= 164.7817 - 162.6006 = 2.1811$	
$SS(AB) = \frac{(12.3^2 + 9.2^2 + \dots + 7.5^2)}{3} - CF - SS(A) - SS(B)$ $= 169.93 - 162.6006 - 5.0139 - 2.1311 = .1344$				

Table 3: ANOVA table for A Flame Retardant

Jadual 3: Jadual ANOVA untuk perencat nyalaan

Source	df	SS	MS	F
Laboratory (A)				
Material (B)				
Interaction (AB)				
Error				
Total				
S=0.2236	R-Sq=92.43%		R-Sq(adj) =89.28%	

Assume the significance level is $\alpha=0.05$. Answer the following questions:

Andaikan aras keertian adalah $\alpha = 0.05$. Jawab soalan- soalan berikut:

- (i) State the hypotheses of interest in this experiment.

Nyatakan hipotesis kepentingan dalam eksperimen ini.

(10 marks/markah)

- (ii) Based on the given data, construct the table and complete the empty cells.

Berdasarkan data yang diberikan, bina jadual dan lengkapkan sel-sel kosong.

(30 marks/markah)

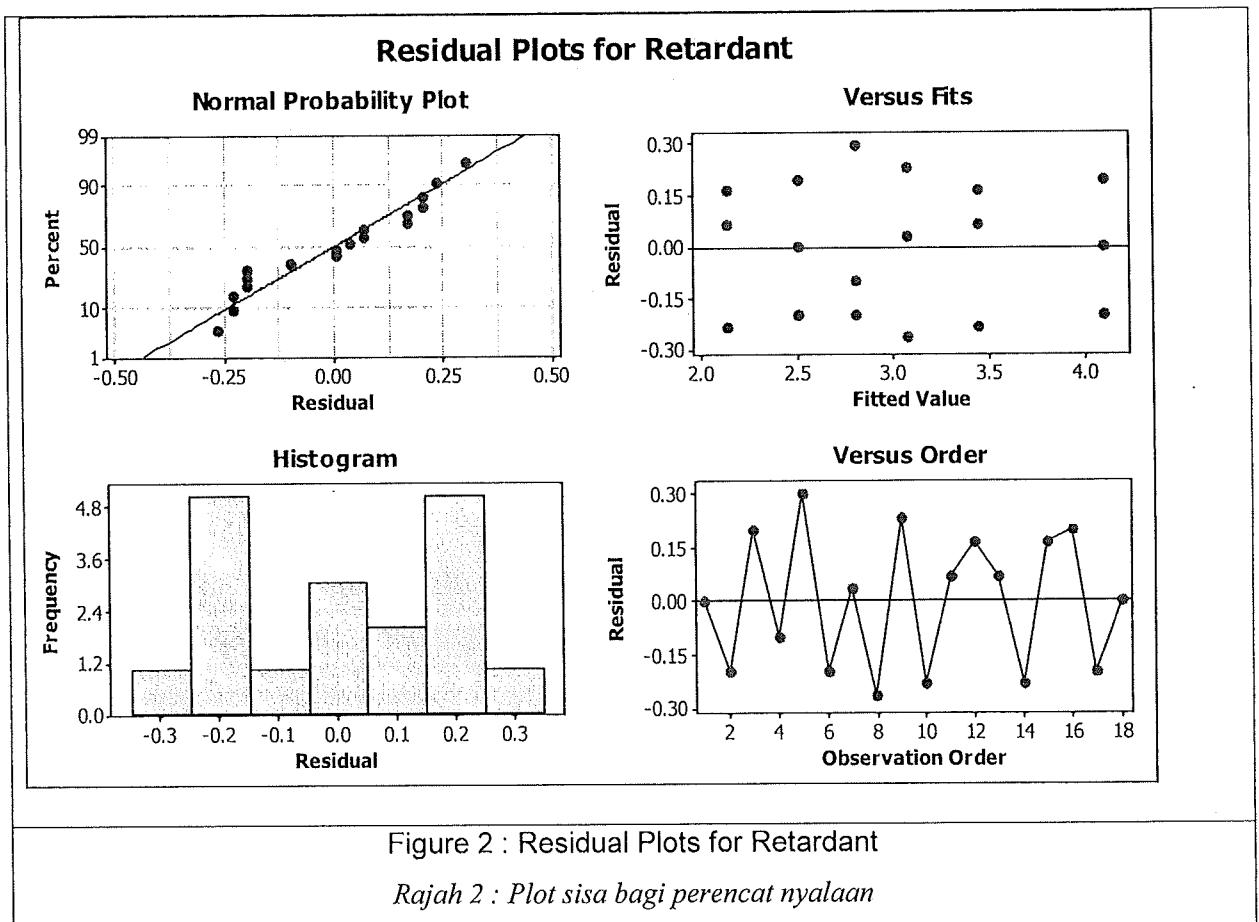
- (iii) Test the hypotheses in part a(i) and draw your conclusions using the analysis of variance (ANOVA).

Uji hipotesis di bagian (i) dan buat kesimpulan anda dengan menggunakan analisis varians (ANOVA) .

(10 marks/markah)

- [b] Using the data from experiment 4[a], you have been asked to make an analysis report for your DOE assignment and submit to your EBB300 lecturer.

Dengan menggunakan data daripada eksperimen 4 [a], anda telah diminta untuk membuat satu laporan analisis untuk tugas DOE dan dihantar kepada pensyarah EBB300 anda.

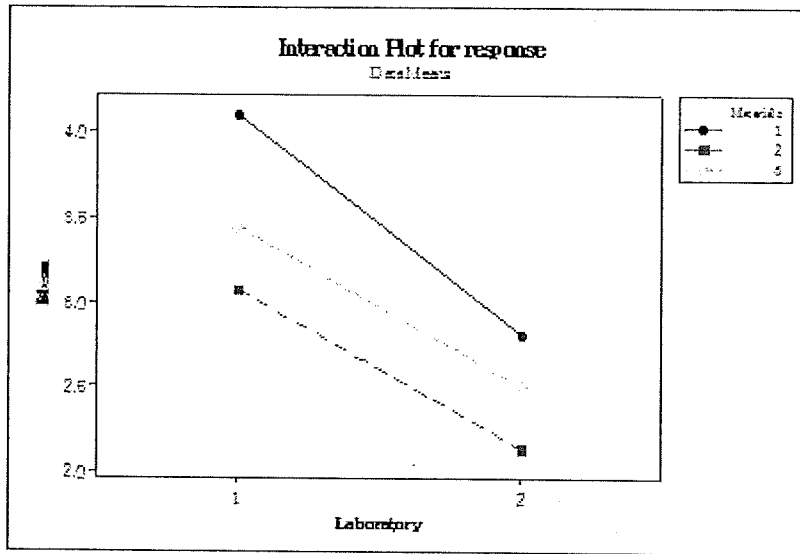
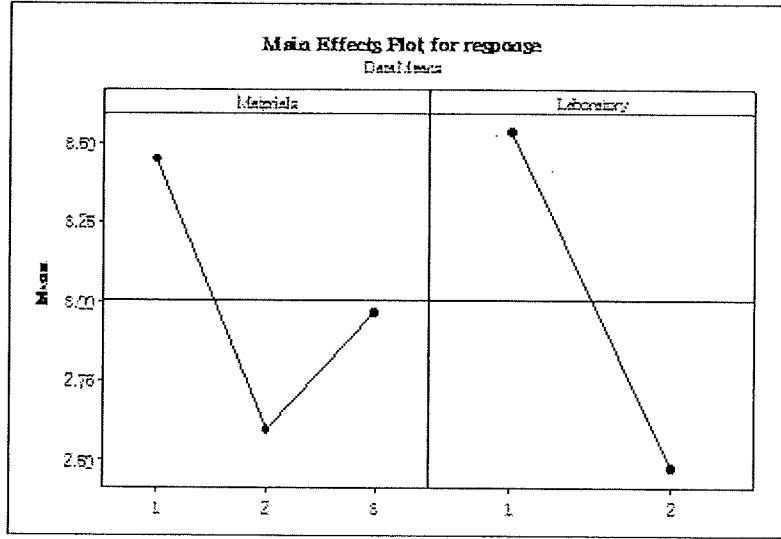


- (i) Analyze the Residual Plots for Retardant and provide your analysis for each graph from Figure 2

Buat analisa Plot sisa untuk perencat nyalaan dan sediakan analisis anda untuk setiap graf daripada Rajah 2.

(15 marks/markah)

Main Effects Plot



Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev	CI Lower	CI Upper
1	6	3.4500	0.7423	2.5000	4.4000
2	6	2.6000	0.5514	2.0000	3.2000
3	6	2.9667	0.5428	2.3000	3.6333

Pooled StDev = 0.6190

Grouping Information Using Tukey Method

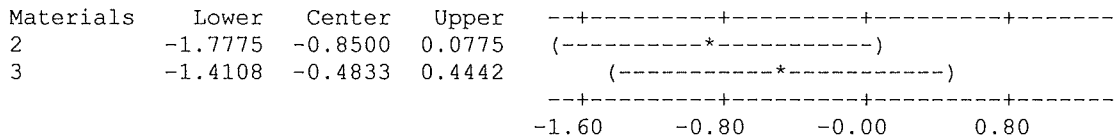
Materials	N	Mean	Grouping
1	6	3.4500	A
3	6	2.9667	A
2	6	2.6000	A

Means that do not share a letter are significantly different.

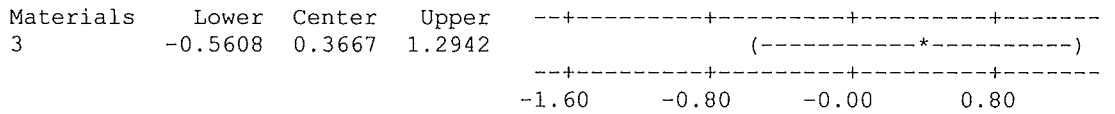
Tukey 95% Simultaneous Confidence Intervals
All Pairwise Comparisons among Levels of Materials

Individual confidence level = 97.97%

Materials = 1 subtracted from:



Materials = 2 subtracted from:



Grouping Information Using Fisher Method

Materials	N	Mean	Grouping
1	6	3.4500	A
3	6	2.9667	A B
2	6	2.6000	B

Means that do not share a letter are significantly different.

Figure 3: Interaction Plot For Fire Retardant And Grouping Information On Factors Using Turkey Method

Rajah 3: Plot Interaksi Untuk Perencat Nyalaaan Dan Maklumat kumpulan Mengenai Faktor-Faktor Menggunakan Kaedah Turkey

- (ii) Provide your simple analysis for Materials and Grouping Information on factors using the Interaction Plot and Turkey Method in Figure 3.

Sediakan analisis mudah anda untuk Bahan dan Maklumat kumpulan mengenai faktor-faktor dengan menggunakan Plot Interaksi dan Kaedah Turkey dalam Rajah 3.

.(15 marks/markah)

- (iii) Write a conclusion on the success of this project.

Tulis satu kesimpulan untuk kejayaan projek ini.

(20 marks/markah)

5. [a] Bread Maker factory decided to investigate the possible way to increase the yield of cookies for the two factors, Temperature and Water in the production line. They baked 3 batches of cookies with each of the four treatment combinations (1), t, w, and tw and produced the following result .

Kilang Pembuat Roti memutuskan untuk menyiasat cara yang mungkin untuk meningkatkan hasil biskut untuk kedua-dua faktor, suhu dan air di jalur pembuatan. Mereka membakar 3 kelompok biskut dengan setiap satu daripada empat gabungan rawatan (1), t, w, dan tw serta menghasilkan keputusan seperti berikut:

<u>Goal: Yield</u>				
yield	temperature	water	batch	
1	31	-1	-1	1
2	29	-1	-1	2
3	30	-1	-1	3
4	40	1	-1	1
5	42	1	-1	2
6	38	1	-1	3
7	51	-1	1	1
8	49	-1	1	2
9	50	-1	1	3
10	61	1	1	1
11	60	1	1	2
12	60	1	1	3

Temperature

- Low: 140 °C
- High: 180 °C

(Temperature A)

Water :

- Low: 50ml
- High: 150ml

(Water B)

Surface Plot of yield vs water, temperature

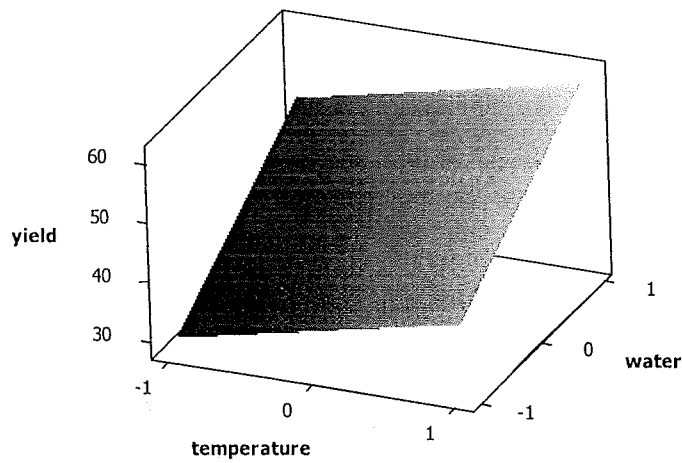


Figure 4 : Surface Plot Yield vs Water and Temperature

Rajah 4 : Permukaan Plot Hasil lwn Air dan Suhu

Table 4: Cookies Treatments

Jadual 4: Rawatan biskut

Treatment name	Temp	Water	Rep1	Rep2	Rep3	Average
(1)	-	-	31	29	30	30
t	+	-	40	42	38	40
w	-	+	51	49	50	50
tw	+	+	61	60	60	60.3

- (i) The 2^2 design can also be represented geometrically using a square with the four treatment combinations called *orthogonal design*. Draw the *orthogonal design square*.

Reka bentuk 2^2 juga boleh diwakili secara geometri menggunakan empat gabungan rawatan yang dipanggil reka bentuk ortogon. Lukis reka bentuk ortogon persegi.

(10 marks/markah)

- (ii) Calculate the main effects and interaction of water and temperature for the cookies yield using the *orthogonal design*.

Kirakan kesan utama dan interaksi air dan suhu untuk penghasilan biskut dengan menggunakan reka bentuk ortogon.

(15 marks/markah)

- (iii) Use Surface Plot Yield vs Water and Temperature with the calculation results of 5a(ii) and provide your comparison analysis for the cookies yield if the current average treatment $tw=60.3$ change to $tw=30$.

Menggunakan Plot Permukaan Hasil vs Air dan Suhu serta keputusan pengiraan 5a (ii) dan sediakan analisis perbandingan anda untuk hasil biskut jika purata semasa rawatan $tw = 60.3$ diubah kepada $tw = 30$.

(25 marks/markah)

- [b] Use the Figure 4 Yield vs Water and Temperature information for further regression analysis.

Gunakan maklumat Rajah 4 Hasil vs Air dan suhu untuk analisis regresi selanjutnya.

Table 5: Two-way ANOVA: Factorial Fit: yield versus water, temperature in Minitab
 Jadual 5: ANOVA Dua hala: Faktor Berpadanan: Hasil Berbanding Air, Suhu di Minitab

Estimated Effects and Coefficients for yield (coded units)

Term	Effect	Coef	SE Coef	T
Constant		45.0833	0.3632	124.11
water	20.1667	10.0833	0.3632	27.76
temperature	10.1667	5.0833	0.3632	13.99
water*temperature	0.1667	0.0833	0.3632	0.23

S = 1.25831 PRESS = 28.5
 R-Sq = 99.18% R-Sq(pred) = 98.15% R-Sq(adj) = 98.87%

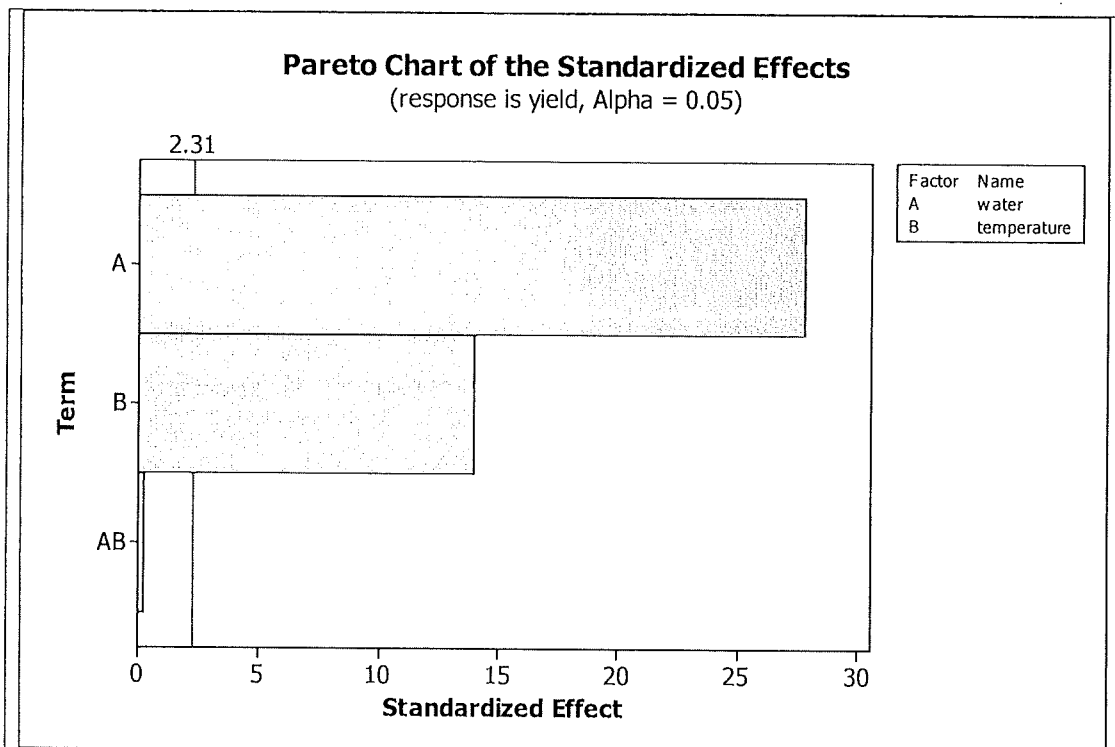


Figure 5 : Pareto Chart of the Standardized Effects

Rajah 5 : Carta Pareto daripada Kesan Piawaian

- (i) State the general linear model which can fit for this experiment. Use the corresponding ANOVA table to polynomial state the general model and calculate both coded and uncoded variables form of regression equations .

Nyatakan model linear am yang sesuai untuk eksperimen ini. Gunakan jadual ANOVA yang sepadan untuk keadaan polinomial model umum dan kira persamaan regresi untuk kedua-dua bentuk berkod dan pembolehubah tidak berkod.

(25 marks/markah)

- (ii) Let say Bread Maker factory decided to increase their cookies yield by changing their current factor treatments from Temperature(A) =150 °C and Water (B) = 60 ml to Temperature(A) =160 °C and Water (B) = 100 ml . Do you think Bread Maker factory able to get better Yield for his experiment? Justify your answer with quantitative analysis and pareto chart of standardized effects.

Katakan kilang Bread Maker memutuskan untuk meningkatkan hasil biskut mereka dengan menukar rawatan faktor semasa mereka dari Suhu (A) = 150 °C dan Air (B) = 60 ml untuk Suhu (A) = 160 °C dan Air (B) = 100 ml. Adakah anda fikir kilang Bread Maker mampu untuk mendapatkan hasil yang lebih baik untuk eksperimen beliau? Jelaskan jawapan anda dengan analisis kuantitatif dan Carta Pareto daripada Kesan Piawaian.

(25 marks/markah)

6. [a]. A wafer semiconductor company has initiated their research & development on wafer structure using the application of three-level factorial designs in the integrated circuit manufacturing. The basic processing step is to effectively grow an epitaxial layer on polished silicon wafers. The wafers mounted on a susceptor are positioned inside a bell jar, and chemical vapors are introduced. The susceptor is rotated and heat is applied until the epitaxial layer is thick enough. An experiment was run using three factors: Trichlorosilane (SiHCl_3) + Hydrogen (H_2) flow rate (A), temperature (B) and deposition time (C). Two replicates were run, and the epitaxial layer thickness was measured (in mm). The data are shown as follows:

Sebuah syarikat wafer semikonduktor telah memulakan penyelidikan dan pembangunan ke atas struktur wafer menggunakan aplikasi reka bentuk faktorial tiga aras dalam pembuatan litar bersepadu. Langkah pemprosesan asas adalah untuk membentuk lapisan epitaksi berkesan pada wafer silikon yang digilap. Wafer dipasang pada susceptor yang diletakkan di dalam sebuah balang loceng, dan wap kimia dimasukkan. Susceptor diputar dan haba digunakan sehingga lapisan epitaksi cukup tebal. Satu eksperimen telah dijalankan dengan menggunakan tiga faktor: kadar Aliran (A) Triklorosilana (SiHCl_3) + Hidrogen (H_2), suhu (B) dan masa pemendapan (C) mengalir. Dua replika telah dijalankan, dan ketebalan lapisan epitaksi diukur (dalam mm). Data adalah seperti ditunjukkan seperti berikut:

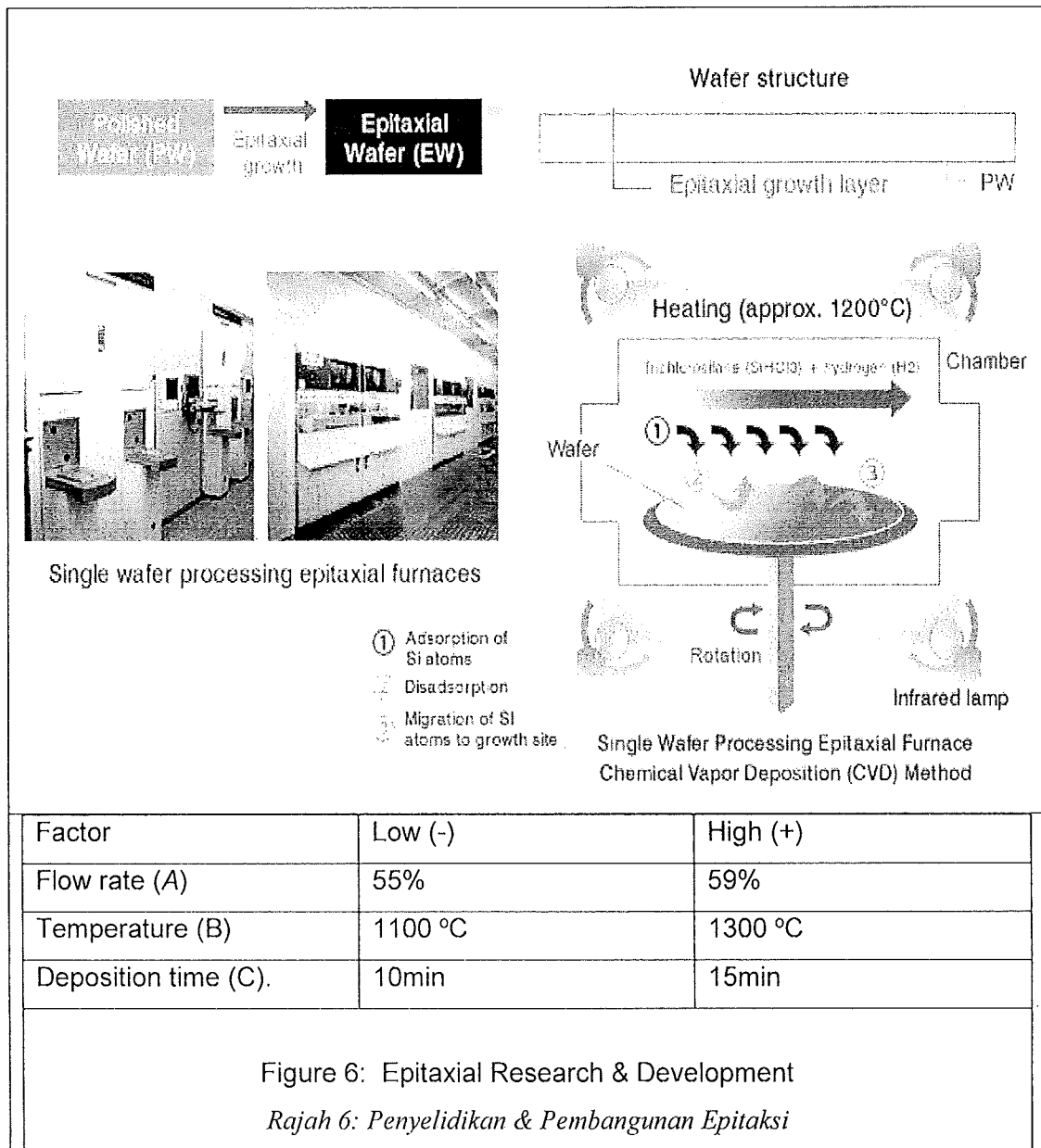


Table 5: Factors Treatment for Epitaxial

Jadual 5: Faktor Rawatan untuk Epitaksi

Treatment	<u>A</u>	<u>B</u>	<u>C</u>	<u>AB</u>	<u>AC</u>	<u>BC</u>	<u>ABC</u>	Epit axial 1	Epit axial 2	Average
(1)	-1	-1	-1	1	1	1	-1	16.9	16.0	16.5
a	1	-1	-1	-1	-1	1	1	25.3	25.3	25.3
b	-1	1	-1	-1	1	-1	1	15.0	15.7	15.3
ab	1	1	-1	1	-1	-1	-1	47.7	47.3	47.5
c	-1	-1	1	1	-1	-1	1	17.3	17.6	17.4
ac	1	-1	1	-1	1	-1	-1	24.9	26.0	25.5
bc	-1	1	1	-1	-1	1	-1	14.4	16.9	15.6
abc	1	1	1	1	1	1	1	47.3	46.8	47.1
Average of +1 runs	36.3	31.4	26.4	32.3	26.1	26.1	26.3			
Average of -1 runs	16.2	21.2	26.1	20.4	26.5	26.4	26.3			
Difference (effect)	20.1	10.2	0.3	11.9	-0.4	-0.3	0.0			

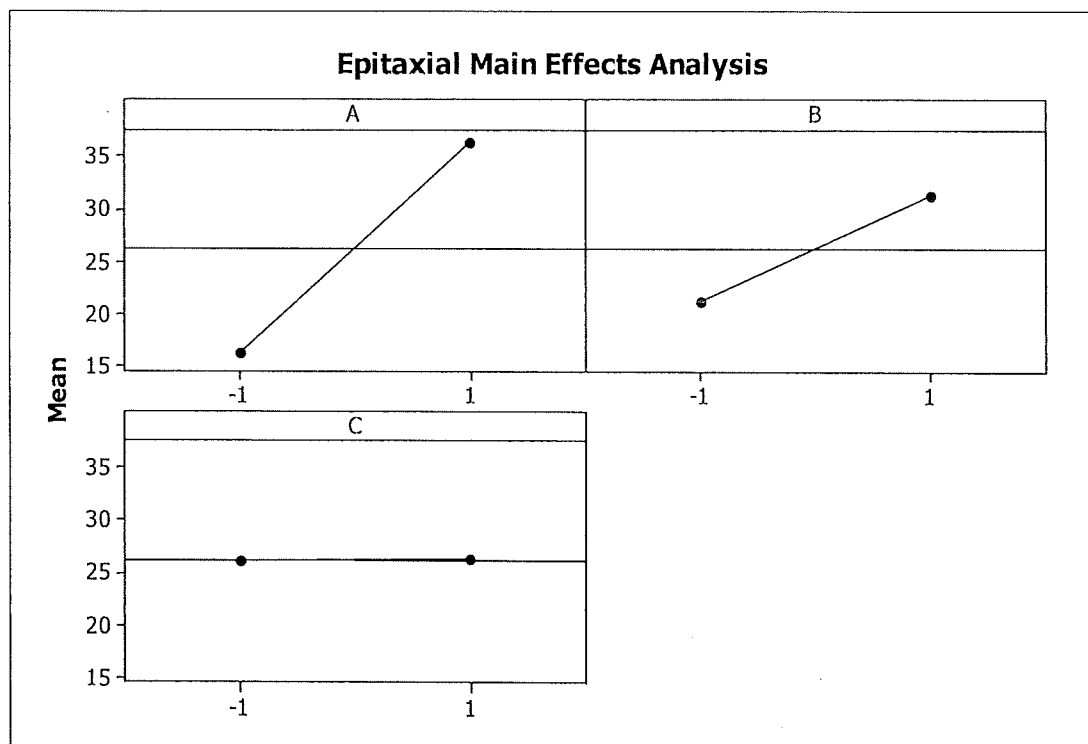


Figure 7 : Epitaxial Main Effects Analysis

Rajah 7 : Analisis Epitaksi Kesan utama

Interaction Plot for Epitaxial Data Means

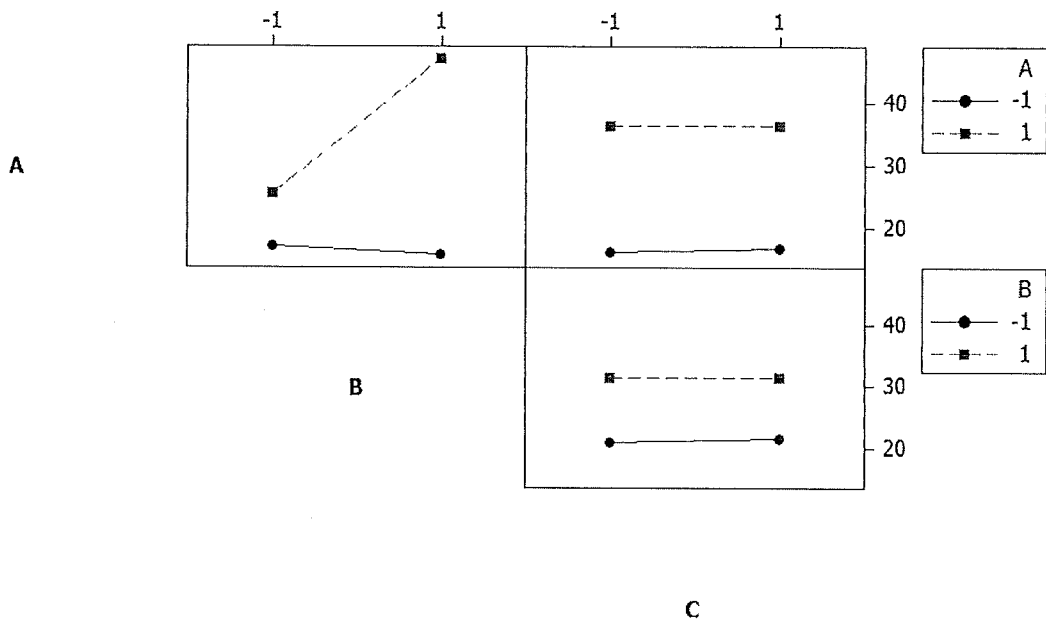


Figure 8: Epitaxial Interaction plot

Rajah 8: Plot interaksi Epitaksi

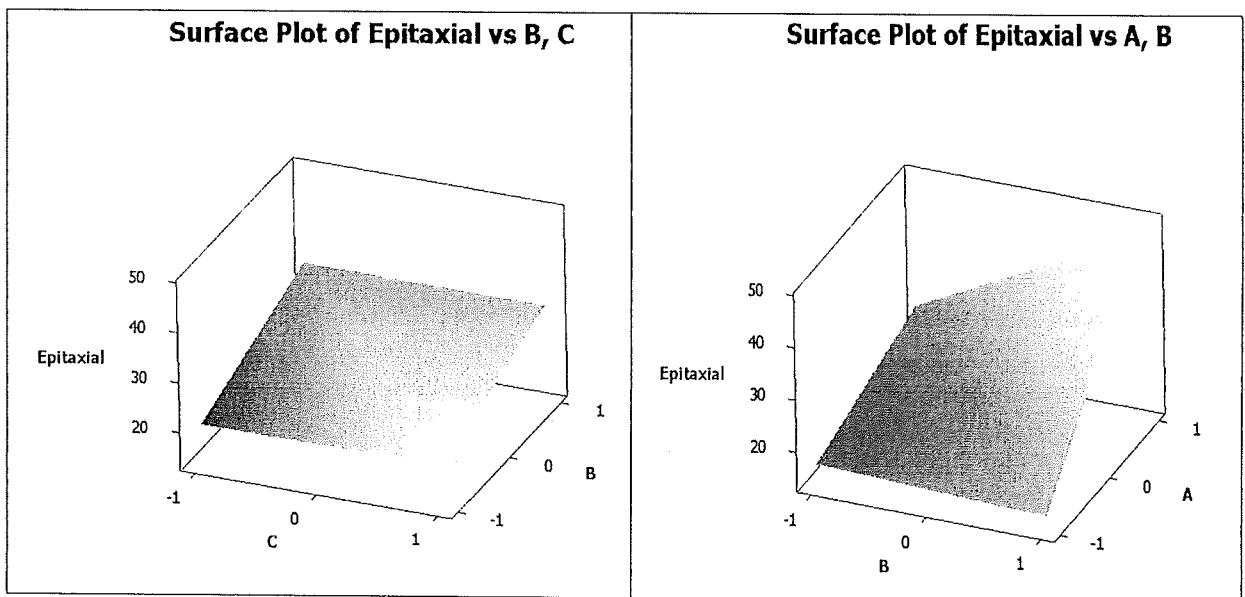


Figure 9 : Epitaxial Surface plot

Rajah 9 : Plot Permukaan Epitaksi

- (i) Draw a cube plot (data means) for the epitaxial and infer an appropriate general statistical model for this experiment ?

Lukiskan satu plot kiub (min data) bagi epitaksi dan buat kesimpulan model umum statistik yang sesuai untuk eksperimen ini?

(15 marks/markah)

- (ii) Conduct an analysis for main effect Figure 7 , interaction Figure 8 and surface plot Figure 9 for epitaxial. Which factors and interactions are important?

Jalankan suatu analisis untuk kesan utama Rajah 7, interaksi Rajah 8 dan permukaan plot Rajah 9 untuk epitaksi. Faktor dan interaksi yang mana adalah penting?

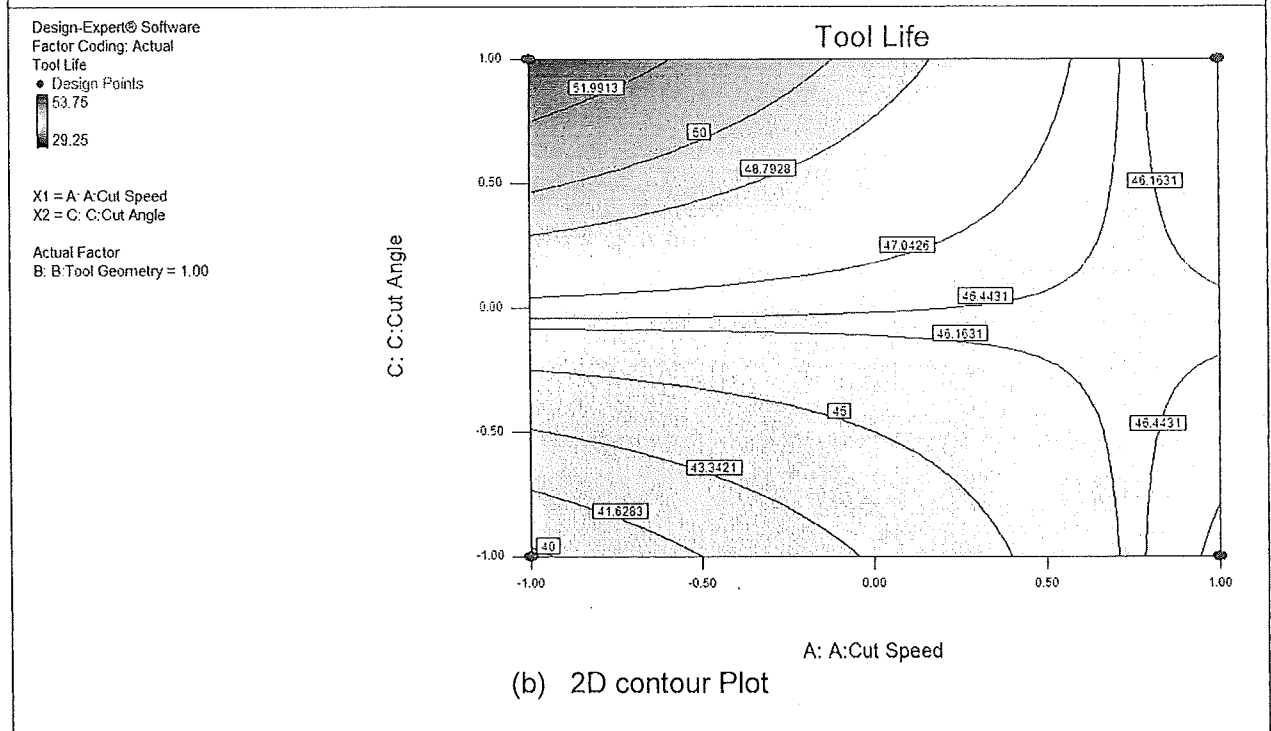
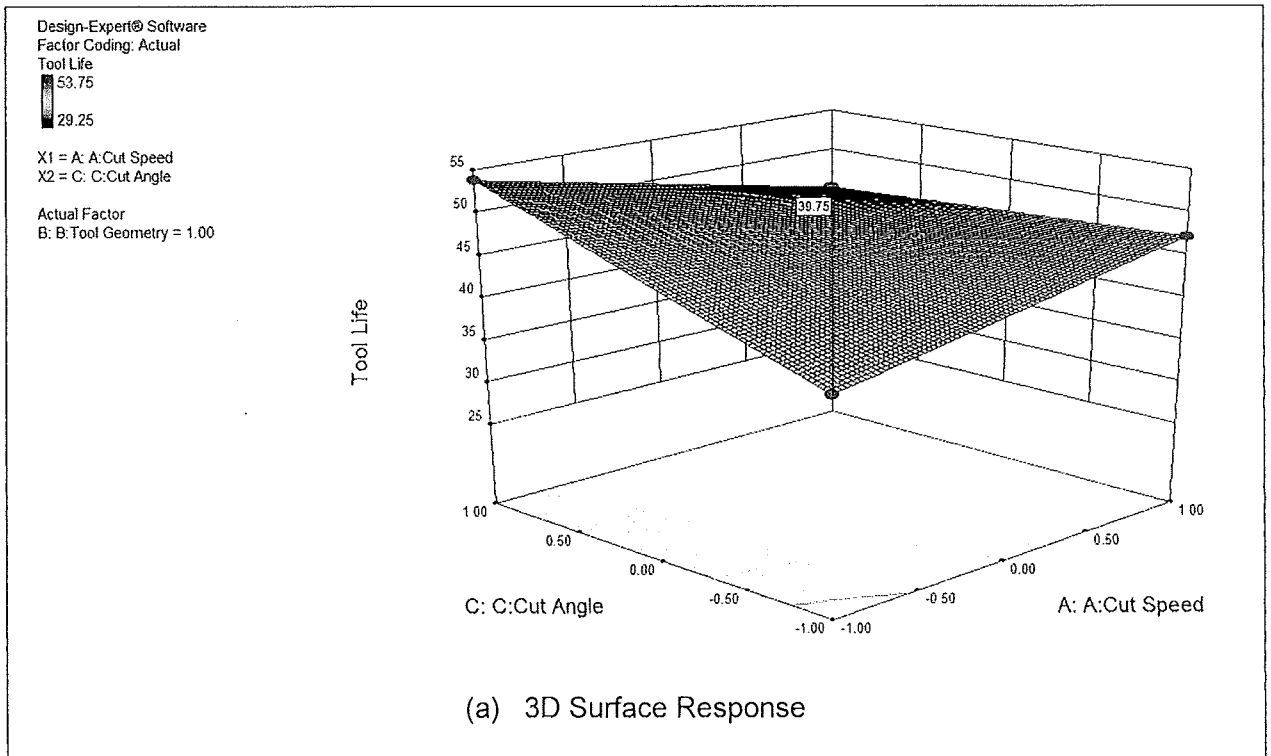
(15 marks/markah)

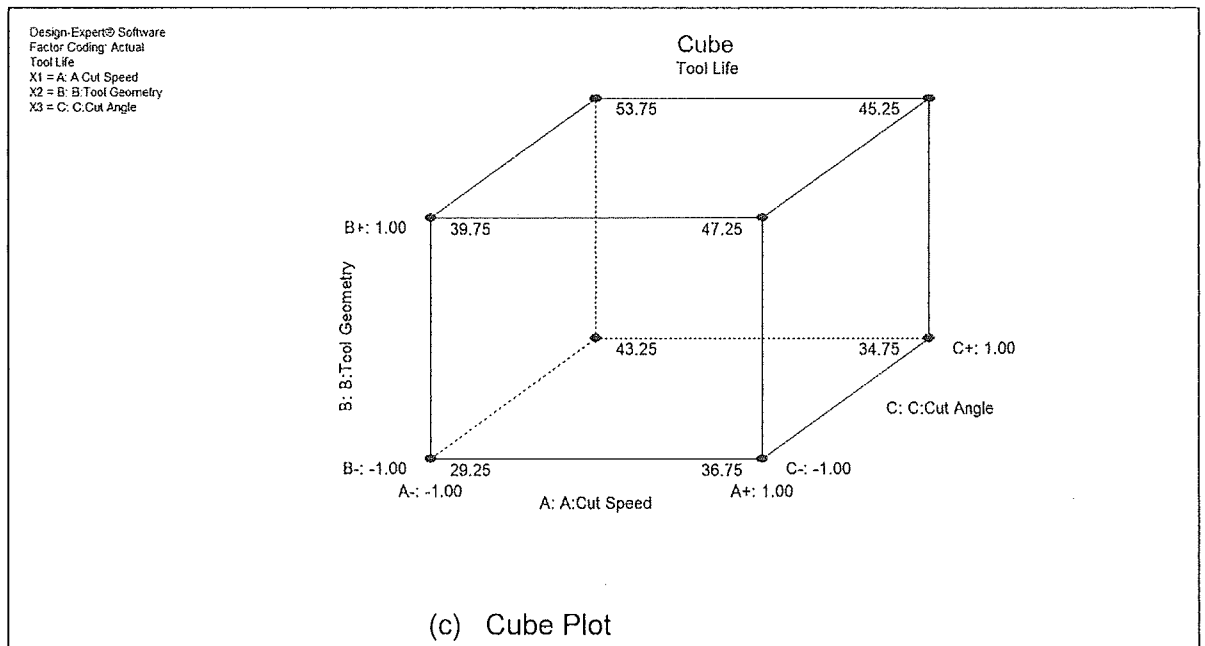
- (iii) Write down a general regression equation that could be used to predict epitaxial layer thickness over the region of flow rate, temperature and deposition time used in this experiment after elimination of certain regression equation terms. Justify your new general regression equation and provide the reason for its terms elimination.

Tuliskan satu persamaan regresi umum yang boleh digunakan untuk meramalkan ketebalan lapisan epitaksi seluruh rantau ini daripada kadar aliran, suhu dan masa pemendapan digunakan dalam eksperimen ini selepas pengeluaran istilah faktor persamaan regresi tertentu. Jelaskan persamaan regresi umum baru anda dan berikan alasan untuk pengeluaran istilah faktor persamaan regresi tertentu.

(20 marks/markah)

6. [b]





Figures 10 : (a) 3D Surface Response and (b) 2D contour Plot (c) Cube plot for **A = Cut Speed, B = Tool Geometry, C = Cut Angle** as factors for Tool life response.

Rajah 10 : (a) Permukaan Respons 3D dan (b) Plot kontur 2D (c) Plot Kubik untuk **A = Cut Speed, B = Tool Geometry, C = Cut Angle** sebagai faktor respon Jangka Hayat Perkakas.

- (i) Identify the significant terms for the Tool life response and give your reason for your choices?

Kenal pasti istilah faktor penting bagi respon Jangka Hayat perkakas dan beri alasan anda untuk pilihan anda?

(15 marks/markah)

- (ii) What operating conditions would you recommend if the objective is to operate the process at a mean Tool life very close to 46?

Apakah syarat-syarat operasi yang anda akan cadangkan jika tujuannya operasi ini adalah untuk mengendalikan proses Jangka Hayat perkakas pada min sangat dekat dengan 46?

(15 marks/markah)

- (iii) Write an analysis summary to conclude the (a) 3D Surface Response and (b) 2D contour Plot (c) Cube plot as factors for Tool life response.

Tulis suatu rumusan analisis untuk menyimpulkan (a) Permukaan 3D respon dan (b) Plot 2D kontur (c) plot kiub bagi respon Jangka Hayat perkakas.

(20 marks/markah)

