SULIT

KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN MATEMATIK, SAINS & KOMPUTER

PEPERIKSAAN AKHIR

SESI II : 2024/2025

DBM30033 : ENGINEERING MATHEMATICS 3

TARIKH : 16 MEI 2025
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **SEPULUH (10)** halaman bercetak.

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Kertas Graf dan Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:
This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **EMPAT (4)** soalan struktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1

(a) Table 1(a) shows the distribution of monthly electricity consumption of 50 consumers in a locality.

Jadual 1(a) menunjukkan taburan penggunaan bulanan elektrik bagi 50 orang pengguna di dalam sebuah lokaliti.

Table 1(a) / *Jadual 1(a)*

Monthly consumption (in unit) *Penggunaan bulanan (dalam unit)*	Number of consumers *Jumlah pengguna*
81 - 90	10
91 - 100	9
101 - 110	15
111 - 120	10
121 - 130	6

Based on the table, calculate:
Berdasarkan jadual, kirakan:

i. mode
mod

[4 marks]
[*4 markah*]

ii. variance
varians

[6 marks]
[*6 markah*]

CLO1 (b) Given a set of data 3, 7, 6, 12, 8, 4, x and 12. Calculate the value of:
Diberi satu set data 3, 7, 6, 12, 8, 4, x dan 12. Kira nilai bagi:

i. x, if the mean is 8
x, jika min adalah 8

[3 marks]
[*3 markah*]

ii. standard deviation
sisihan piawai

[5 marks]
[*5 markah*]

CLO1 (c) A drawer contains 5 white shirts, 8 black shirts and 9 yellow shirts. Two shirts are selected at random without replacement. Determine the probability of choosing:
Sebuah laci mengandungi 5 helai baju berwarna putih, 8 helai baju berwarna hitam dan 9 helai baju berwarna kuning. Dua helai baju dipilih secara rawak tanpa diganti. Tentukan kebarangkalian memilih:

i. shirts with the same colour
kemeja yang berwarna sama

[4 marks]
[*4 markah*]

ii. shirts that have the combination of white and black colour
kemeja yang mempunyai gabungan warna putih dan hitam

[3 marks]
[*3 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) Based on the linear equations below:

Berdasarkan persamaan linear di bawah:

$$2x - y - 2z = -1$$

$$-4x + 6y = 13 - 3z$$

$$-4x - 2y + 8z = -6$$

i. Construct Matrix L and Matrix U using the Crout method

Bina Matriks L dan U menggunakan Kaedah Crout

[10 marks]
[*10 markah*]

ii. Then, calculate value of x, y and z

Kemudian, kira nilai x, y dan z

[8 marks]
[*8 markah*]

CLO1 (b) By using the Newton Raphson Method, determine the root for the function $f(x) = x^4 - x - 10$ correct to 3 decimal places. Given that $x_0 = 2.5$.

Dengan menggunakan Kaedah Newton Raphson, tentukan fungsi bagi $f(x) = x^4 - x - 10$ *tepat kepada 3 tempat perpuluhan. Diberi* $x_0 = 2.5$.

[7 marks]
[*7 markah*]

QUESTION 3

SOALAN 3

CLO1 (a) Express the order and degree of the following differential equations:

Nyatakan peringkat dan darjah bagi persamaan pembezaan yang berikut:

i. $4\left(\frac{d^3y}{dx^3}\right) - \left(\frac{d^2y}{dx^2}\right)^3 + 5\frac{dy}{dx} + 4 = 0$

[2 marks]
[*2 markah*]

ii. $\left(\frac{d^4y}{dx^4}\right)^2 + \left(\frac{dy}{dx}\right) - \cos^3 x = 0$

[2 marks]
[*2 markah*]

CLO1 (b) Solve the following differential equations by applying the stated method.

Selesaikan persamaan berikut dengan menggunakan kaedah yang dinyatakan.

i. $\frac{dy}{dx} = e^{5x} - 4x + 3$; Direct Integration

; *Pengamiran langsung*

[5 marks]
[*5 markah*]

ii. $\frac{dy}{dx} + \frac{y}{x} = x^2$; Integrating Factor

; *Faktor Pengamiran*

[6 marks]
[*6 markah*]

CLO1 (c) Determine the general solution for the following differential equations:

Tentukan penyelesaian am bagi persamaan pembezaan berikut:

i. $2\frac{d^2y}{dx^2} - 3\frac{dy}{dx} = 2y$

[5 marks]
[*5 markah*]

ii. $\frac{d^2y}{dx^2} + 7y = 3\frac{dy}{dx}$

[5 marks]
[*5 markah*]

QUESTION 4

SOALAN 4

CLO1 (a) A factory wants to produce **TWO (2)** types of electronic devices, A and B using a single machine. In one day, the machine produces x units of electronic device A and y units of electronic device B. The time required to produce one unit of electronic device A is 8 minutes, while 6 minutes are needed to produce one unit of electronic device B. The production of these electronic devices is subject to the following constraints. The total number of electronic devices produced must exceed 50 units per day.The machine can operate for only 18 hours per day.The factory aims to achieve a maximum daily profit of RM3 per unit for electronic device A and RM2 per unit for electronic device B. Identify the variables, objective function and all the constraints that satisfy the condition other than $x \geq 0$ and $y \geq 0$.

*Sebuah kilang ingin menghasilkan **DUA (2)** jenis alat elektronik, A dan B dengan menggunakan sebuah mesin. Dalam sehari mesin tersebut menghasilkan x unit alat elektronik jenis A dan y unit alat elektronik jenis B. Masa yang diperlukan untuk menghasilkan seunit alat elektronik jenis A adalah 8 minit dan 6 minit untuk menghasilkan seunit alat elektronik jenis B.Penghasilan alat-alat elektronik tersebut adalah berdasarkan kepada kekangan berikut.Jumlah alat elektronik yang dihasilkan mesti melebihi 50 unit dalam sehari. Mesin tersebut hanya boleh beroperasi selama 18 jam sehari. Kilang tersebut ingin mendapatkan maksimum keuntungan setiap hari sebanyak RM3 dan RM2 bagi setiap unit alat elektronik A dan alat elektronik B. Kenalpasti pemboleh ubah, fungsi objektif dan semua kekangan yang memenuhi syarat selain daripada* $x \geq 0$ *dan* $y \geq 0$.

[5 marks]

[*5 markah*]

CLO1 (b) An electronics company produces **TWO (2)** types of circuit boards, PCBY and PCBZ. The production of these circuit boards requires an assembly process and a final inspection. The Table 4(b) below shows the time taken for the assembly and final inspection process per unit for both types of circuit boards.

*Sebuah syarikat elektronik mengeluarkan **DUA (2)** jenis papan litar, PCBY dan PCBZ. Penghasilan papan litar tersebut memerlukan proses pemasangan dan pemeriksaan akhir. Jadual 4(b) di bawah menunjukkan masa yang diambil untuk proses pemasangan dan pemeriksaan akhir bagi satu unit untuk kedua-dua jenis papan litar tersebut.*

Table 4(b) / *Jadual 4(b)*

Circuit board *Papan litar*	Time taken (minutes) *Masa diambil (minit)*	
	Assembly *Pemasangan*	Final inspection *Pemeriksaan akhir*
PCBY	30	2
PCBZ	25	5

The company produces x units of PCBY circuit boards and y units of PCBZ circuit boards each day. The maximum total time for assembling both types of circuit boards is 600 minutes. The total time used for the final inspection of both types is at least 50 minutes. The profit obtained from **ONE (1)** unit of PCBY circuit board is RM40, while the profit for the PCBZ circuit board is RM45.

*Syarikat tersebut menghasilkan x unit papan litar PCBY dan y unit papan litar PCBZ setiap hari. Jumlah masa maksimum bagi pemasangan kedua-dua jenis papan litar ialah 600 minit. Jumlah masa yang digunakan untuk pemeriksaan akhir bagi kedua-dua jenis ialah sekurang-kurangnya 50 minit. Keuntungan diperolehi daripada **SATU (1)** unit papan litar PCBY ialah RM40 dan keuntungan papan litar PCBZ ialah RM45.*

i. Draw the graph and shade the region R that satisfies all the stated constraints.
Lukiskan graf dan lorekkan rantau R yang memenuhi semua kekangan yang dinyatakan.

[7 marks]
[*7 markah*]

ii. Calculate the maximum profit for this company.
Kira keuntungan maksimum bagi syarikat ini.

[3 marks]
[*3 markah*]

CLO1 (c) Given Linear Programming problem with maximum value of objective function $Z = 3x_1 + 2x_2$ with constraints:
Diberi permasalahan pengaturcaraan linear dengan nilai maksimum bagi fungsi objektif $Z = 3x_1 + 2x_2$ *dengan kekangan:*

$$3x_1 + x_2 \leq 12$$
$$x_1 + x_2 \leq 6$$
$$5x_1 + 3x_2 \leq 27$$
$$x_1, x_2 \geq 0$$

i. Write the problem in Standard Simplex form.
Tuliskan pernyataan masalah dalam bentuk Simplex Piawai.

[2 marks]
[*2 markah*]

ii. Based on the answer for c(i), change the Standard Simplex form equations to First Initial Tableau.
Berdasarkan jawapan c(i), tukarkan persamaan bentuk Simplex Piawai tersebut kepada Jadual Permulaan Tableau.

[2 marks]
[*2 markah*]

iii. Solve the First Initial Tableau to get the optimal solution.
Selesaikan Jadual Permulaan Tableau tersebut untuk mendapatkan penyelesaian optimum.

[6 marks]
[*6 markah*]

SOALAN TAMAT

FORMULA DBM30033 - ENGINEERING MATHEMATICS 3

DESCRIPTIVE STATISTICS		
Number of class	*Sturges Rule*, $k = 1 + 3.33 \log n$	*Rule of Thumb*, $2^k > n$
Mean	$\bar{x} = \frac{\sum x}{n}$	$\bar{x} = \frac{\sum (fx)}{\sum f}$
Median	$Median = L_m + \left(\frac{\frac{N}{2} - F}{f_m}\right)C$	
Mode	$Mode = L_{M_o} + \left(\frac{d_1}{d_1 + d_2}\right)C$	
Quartile	$Q_k = L_{Q_k} + \left(\frac{\frac{kN}{4} - F}{f_{Q_k}}\right)C; \quad k = 1, 2, 3$	
Decile	$D_k = L_{D_k} + \left(\frac{\frac{kN}{10} - F}{f_{D_k}}\right)C; \quad k = 1, 2, 3...9$	
Percentile	$P_k = L_{P_k} + \left(\frac{\frac{kN}{100} - F}{f_{P_k}}\right)C; \quad k = 1, 2, 3...99$	
Mean Deviation	$E = \frac{\sum \lvert x - \bar{x} \rvert}{n}$	$E = \frac{\sum (\lvert x - \bar{x} \rvert f)}{\sum f}$
Variance	$s^2 = \frac{\sum (x - \bar{x})^2}{n}$	$s^2 = \frac{\sum_{i=1}^{n} x_i^2 - n\bar{x}^2}{n}$
	$s^2 = \frac{\sum [(x - \bar{x})^2 f]}{\sum f}$	$s^2 = \frac{\sum fx^2}{\sum f} - \left[\frac{\sum fx}{\sum f}\right]^2$
Standard Deviation	$s = \sqrt{variance}$	

NUMERICAL METHOD		
Crout Method	$A = \begin{pmatrix} l_{11} & 0 & 0 \\ l_{21} & l_{22} & 0 \\ l_{31} & l_{32} & l_{33} \end{pmatrix} \begin{pmatrix} 1 & u_{12} & u_{13} \\ 0 & 1 & u_{23} \\ 0 & 0 & 1 \end{pmatrix}$	$Ly = b$ $Ux = y$

Doolittle Method	$A=\begin{pmatrix}1 & 0 & 0\\ l_{21} & 1 & 0\\ l_{31} & l_{32} & 1\end{pmatrix}\begin{pmatrix}u_{11} & u_{12} & u_{13}\\ 0 & u_{22} & u_{23}\\ 0 & 0 & u_{33}\end{pmatrix}$	
Newton Raphson Method	$x_{n+1}=x_n-\frac{f(x_n)}{f'(x_n)}$	
False Position Method	$x_0=\frac{1}{y_2-y_1}\begin{vmatrix}x_1 & y_1\\ x_2 & y_2\end{vmatrix}$	

PROBABILITY	
$E=pn$	$P(A\cup B)=P(A)+P(B)-P(A\cap B)$
$P(B\|A)=\frac{P(B\cap A)}{P(A)}$	$P(A\cap B)=P(A)P(B)$
	$P(A\cup B)=P(A)+P(B)$
	$P(A\cap B)=P(A)P(B\|A)$

SOLUTION FOR 1st ORDER DIFFERENTIAL EQUATION	
Logarithmic $a=e^{\ln a}$ $a^x=e^a$ $\int a^x dx=\frac{a^x}{\ln a}+c$ $\frac{a^x}{\ln a}+C$	**Homogeneous Equation** $y=vx$ **Linear Factors (Integrating Factors)** $\frac{dy}{dx}+Py=Q$ $y\bullet IF=\int Q\bullet IF\,dx$ Where $I.F=e^{\int P.dx}$ $IF=e^{\int P\,dx}$
GENERAL SOLUTION FOR 2nd ORDER DIFFERENTIAL EQUATION	
Equation of the form $a\frac{d^2y}{dx^2}+b\frac{dy}{dx}+cy=0$	$a\frac{d^2y}{dx^2}+b\frac{dy}{dx}+cy=0$
Quadratics Formula	$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$
1. Real & different roots	$y=Ae^{m_1x}+Be^{m_2x}$
2. Real & equal roots	$y=e^{mx}(A+Bx)$
3. Complex roots	$y=e^{\alpha x}(A\cos\beta x+B\sin\beta x)$

DIFFERENTIATION			
1.	$\frac{d}{dx}(k) = 0\ ,\ k\ is\ constant$	2.	$\frac{d}{dx}\left(ax^{n}\right) = anx^{n-1}$ [Power Rule]
3.	$\frac{d}{dx}(f(x)\pm g(x)) = f'(x)\pm g'(x)$	4.	$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$ [Product Rule]
5.	$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^{2}}$ [Quotient Rule]	6.	$\frac{dy}{dx} = \frac{du}{dx} \times \frac{dy}{du}$ [Chain Rule]
7.	$\frac{d}{dx}\left(e^{x}\right) = e^{x}$	8.	$\frac{d}{dx}\left(e^{ax+b}\right) = e^{ax+b} \times \frac{d}{dx}(ax + b)$
9.	$\frac{d}{dx}(\lvert x\rvert) = \frac{1}{x}$	10.	$\frac{d}{dx}[ln\lvert ax + b\rvert] = \frac{1}{ax+b} \times \frac{d}{dx}(ax + b)$
11.	$\frac{d}{dx}(\sin sin\, x) = \cos cos\, x$	12.	$\frac{d}{dx}(\cos cos\, x) = -\ \sin sin\, x$
13.	$\frac{d}{dx}(\tan tan\, x) = x$	14.	$\frac{d}{dx}[\sin sin\,(ax + b)] = \cos cos\,(ax + b) \times \frac{d}{dx}$
15.	$\frac{d}{dx}[\cos cos\,(ax + b)] = -\ \sin sin\,(ax + b) \times$	16.	$\frac{d}{dx}[\tan tan\,(ax + b)] = (ax + b) \times \frac{d}{dx}(ax +$
17.	$\frac{d}{dx}[u] = nu \times \frac{du}{dx}$	18.	$\frac{d}{dx}[u] = nu \times \frac{du}{dx}$
19.	$\frac{d}{dx}[u] = nu \times \frac{du}{dx}$		

INTEGRATION			
1.	$\int ax^{n}dx = \frac{ax^{n+1}}{n+1} + c\ \ ;\{n \neq -1\}$	2.	$\int (ax + b)^{n}dx = \frac{(ax+b)^{n+1}}{(a)(n+1)} + c\ ;\{n \neq -1\}$
3.	$\int k\,dx = kx + c,\ k\ is\ constant$	4.	$\int_{a}^{b} f(x)dx = F(b) - F(a)$
5.	$\int \frac{1}{x}\,dx = \ln ln\ \lvert x\rvert + c$	6.	$\int \frac{1}{ax+b}\,dx = \lvert ax + b\rvert + c$
7.	$\int e^{x}\,dx = e^{x} + c$	8.	$\int e^{ax+b}\,dx = \frac{1}{a} \times e^{ax+b} + c$
9.	$\int \sin sin\, x\,dx = -\cos cos\, x + c$	10.	$\int \cos cos\, x\,dx = \sin sin\, x + c$
11.	$\int x\,dx = \tan tan\, x + c$		
12.	$\int \sin sin\,(ax + b)\,dx = -(ax + b) + c$		
13.	$\int \cos cos\,(ax + b)\,dx = (ax + b) + c$		
14.	$\int (ax + b)\,dx = \frac{1}{a} \times \tan tan\,(ax + b) + c$		