

**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 DAN KOMPUTER**

**PEPERIKSAAN AKHIR**

**SESI I : 2023/2024**

**DBM30033: ENGINEERING MATHEMATICS 3**

**TARIKH : 20 DISEMBER 2023**

**MASA : 8.30 AM – 10.30 AM (2 JAM)**

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Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Kertas Graf dan Formula

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**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN**

(CLO yang tertera hanya sebagai rujukan)

**SULIT**

**INSTRUCTION:**

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

**ARAHAN:**

*Bahagian ini mengandungi EMPAT (4) soalan berstruktur. Jawab SEMUA soalan.*

**QUESTION 1****SOALAN 1**

CLO1

- (a) Table 1 shows the height of 75 students in a class.

*Jadual 1 menunjukkan ketinggian 75 orang pelajar di dalam sebuah kelas.*

Height (cm) / <i>Ketinggian (cm)</i>	Frequency / <i>Kekerapan</i>
135 – 139	2
140 – 144	7
145 – 149	12
150 – 154	18
155 – 159	20
160 – 164	15
165 – 169	1

Table 1 / *Jadual 1*

Based on the table, calculate:

*Berdasarkan jadual, kirakan:*

- i. The mean height

*Min ketinggian*

[5 marks]

[5 markah]

- ii. Mean deviation

*Sisihan min*

[5 marks]

[5 markah]

- CLO1 (b) Given data set 5, 7, 1, 2 and 4. Calculate:  
*Diberi set data 5, 7, 1, 2 dan 4. Kirakan:*
- i. Mean and median  
*Min dan Median*
- [4 marks]  
 [4 markah]
- ii. Mean deviation  
*Sisihan min*
- [4 marks]  
 [4 markah]
- CLO1 (c) In a selection of school-level speech participants, candidates will be voted by members of the Speech Club where a member can vote for a maximum of two candidates. The probability that Auni ( $A$ ) and Hani ( $H$ ) are voted to participate in the speech is  $\frac{5}{8}$  and  $\frac{1}{4}$  respectively.  
*Dalam satu pemilihan peserta pidato peringkat sekolah, calon-calon akan diundi oleh ahli Kelab Pidato yang mana seorang ahli boleh mengundi maksimum dua orang calon. Kebarangkalian untuk Auni ( $A$ ) dan Hani ( $H$ ) diundi untuk menyertai pidato tersebut ialah masing-masing  $\frac{5}{8}$  dan  $\frac{1}{4}$*
- i. Calculate the probability of Auni or Hani being voted to participate in the speech competition.  
*Hitungkan kebarangkalian Auni atau Hani diundi untuk menyertai pertandingan pidato.*
- [4 marks]  
 [4 markah]
- ii. If the total number of votes is 64, calculate how many votes will be for other than Auni or Hani.  
*Sekiranya jumlah keseluruhan undian adalah 64, kirakan berapakah bilangan undian untuk selain daripada Auni atau Hani.*
- [3 marks]  
 [3 markah]

**QUESTION 2****SOALAN 2**

- CLO1 (a) Based on the following linear equations:  
*Berdasarkan persamaan linear di bawah;*

$$3x + 2y = 7 + 3z$$

$$2x - 4z = 6$$

$$x - 2y + 2z = 12$$

- i. Construct Matrix L and Matrix U by using Crout Method.

*Bina Matriks L dan Matriks U dengan menggunakan Kaedah Crout*

[10 marks]

[10 markah]

- ii. Calculate the value of  $x$ ,  $y$  and  $z$

*Kira nilai  $x$ ,  $y$  dan  $z$*

[8 marks]

[8 markah]

- CLO1 (b) Use the Fixed-Point Iteration Method to find the root for equation  $f(x) = x^3 - 7x + 2$  when  $x_0 = 2.5$ . Give your answer correct to 3 decimal places.

*Gunakan Kaedah Fixed-Point Iteration untuk mencari punca bagi persamaan  $f(x) = x^3 - 7x + 2$  bila  $x_0 = 2.5$ . Berikan jawapan anda tepat kepada 3 tempat perpuluhan.*

[7 marks]

[7 markah]

**QUESTION 3****SOALAN 3**

CLO1

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

*Nyatakan peringkat dan darjah bagi persamaan pembezaan yang berikut:*

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

[2 marks]

[2 markah]

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

[2 marks]

[2 markah]

CLO1

(b) Solve the following first order differential equations:

*Selesaikan persamaan pembezaan peringkat pertama berikut:*

i. 
$$\frac{dy}{dx} = 7x^2 + 3 - \sin x ; \quad \text{Direct Integration}$$

[5 marks]

[5 markah]

ii. 
$$5e^x \frac{dy}{dx} = y ; \quad \text{Separating the Variables}$$

[6 marks]

[6 markah]

CLO1

(c) Solve the following second order differential equations:

*Selesaikan persamaan pembezaan peringkat kedua berikut:*

i. 
$$\frac{d^2y}{dx^2} + 9\frac{dy}{dx} + 20y = 0$$

[4 marks]

[4 markah]

ii. 
$$\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 12y = 0$$

[6 marks]

[6 markah]

## QUESTION 4

## SOALAN 4

- CLO1 (a) A factory produces two types of textiles,  $M$  and  $N$ , each of which requires three types of dyes: dye  $A$ , dye  $B$  and dye  $C$ . The quantity of the dye (kg) needed for each type of textile is given in Table 4(a) below. The total amount available for dye  $A$  is 90kg, dye  $B$  is 180kg and dye  $C$  is 120kg. The profit of textile  $M$  is RM30, and textile  $N$  is RM35. Express the **variables**, **objective function** and **constraints** that meet the description above.

*Sebuah kilang menghasilkan dua jenis tekstil,  $M$  dan  $N$ , masing-masing memerlukan 3 jenis pewarna; Pewarna  $A$ , Pewarna  $B$  dan Pewarna  $C$ . Kuantiti pewarna (kg) yang diperlukan untuk setiap jenis tekstil diberikan dalam Jadual 4(a) di bawah. Jumlah keseluruhan Pewarna  $A$  ialah 90kg, Pewarna  $B$  180kg dan Pewarna  $C$  120kg. Keuntungan bagi tekstil  $M$  ialah RM30 dan tekstil  $N$  ialah RM35. Ungkapkan **pembolehubah**, **fungsi objektif** dan **kekangan** yang memenuhi huraian di atas.*

Table 4(a) / Jadual 4(a)

<i>Textile</i>	<i>Dye Stock (kg)</i>		
	<i>Dye A</i>	<i>Dye B</i>	<i>Dye C</i>
<i>M</i>	7	4	6
<i>N</i>	5	8	4

[5 marks]

[5 markah]

CLO1

- (b) A factory manufactures bed and wardrobe that needs both assembly and finishing operations. Maximum duration for assembly and finishing operations are 10 hours and 20 hours. A bed requires 1 hour of assembly and 4 hours of finishing, while a wardrobe needs 2 hours of assembly and 3 hours of finishing. A profit of RM20 is gained for each bed and RM30 for a wardrobe. The objective function and constraints are stated below.

*Sebuah perusahaan menghasilkan katil dan almari yang memerlukan kedua-dua operasi pemasangan dan pengemasan. Tempoh maksimum bagi operasi pemasangan dan pengemasan adalah 10 jam dan 20 jam. Katil memerlukan 1 jam pemasangan dan 4 jam pengemasan, manakala almari memerlukan 2 jam pemasangan dan 3 jam pengemasan. Keuntungan sebanyak RM20 diperolehi apabila menjual sebuah katil dan keuntungan sebanyak RM30 diperolehi apabila menjual sebuah almari. Fungsi objektif dan kekangan yang memenuhi keterangan dinyatakan seperti di bawah :*

$$Z = 20x + 30y$$

$$x + 2y \leq 10$$

$$4x + 3y \leq 20$$

- i. Construct the graph and shade the region  $R$  that satisfies all the stated constraints.

*Bina graf dan lorekkan rantau  $R$  yang memenuhi semua kekangan yang dinyatakan.*

[7 marks]

[7 markah]

- ii. Calculate the maximum profit for this factory.

*Kira keuntungan maksimum bagi kilang ini.*

[3 marks]

[3 markah]



CLO1

- (c) Given Linear Programming problem with maximum  $Z = 3x + 5y$  with constraint

*Diberi permasalahan Pengaturcaraan Linear dengan maksimum  $Z = 3x + 5y$  dengan kekangan*

$$x + 3y \leq 2$$

$$2x + 2y \leq 3$$

$$x, y \geq 0$$

- i. Write the problem in Standard Simplex Form.

*Tuliskan pernyataan masalah dalam Bentuk Simplex Piawai.*

[2 marks]

[2 markah]

- ii. Solve the given Linear Programming problem by using Simplex Method.

*Selesaikan pengaturcaraan linear yang diberikan dengan menggunakan kaedah Simplex.*

[5 marks]

[5 markah]

- iii. Based on the answer from question (c) ii. above, state the optimum solution of this Linear Programming problem.

*Berdasarkan kepada jawapan soalan (c) ii di atas, nyatakan penyelesaian optimum bagi permasalahan Pengaturcaraan Linear tersebut.*

[3 marks]

[3 markah]

**SOALAN TAMAT**

**FORMULA DBM30033 - ENGINEERING MATHEMATICS 3**

DESCRIPTIVE STATISTICS		
Number of class	<i>Sturges Rule, <math>k = 1 + 3.33 \log n</math></i>	<i>Rule of Thumb, <math>2^k &gt; n</math></i>
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	$D_k = L_{D_k} + \left( \frac{\frac{kN}{10} - F}{f_{D_k}} \right) C; \quad k = 1, 2, 3 \dots 9$	
Percentile	$P_k = L_{P_k} + \left( \frac{\frac{kN}{100} - F}{f_{P_k}} \right) C; \quad k = 1, 2, 3 \dots 99$	
Mean Deviation	$E = \frac{\sum  x - \bar{x} }{n}$	$E = \frac{\sum ( x - \bar{x}  f)}{\sum f}$
Variance	$s^2 = \frac{\sum (x - \bar{x})^2}{n}$	$s^2 = \frac{\sum x_i^2 - n\bar{x}^2}{n}$
	$s^2 = \frac{\sum [ (x - \bar{x})^2 f ]}{\sum f}$	$s^2 = \frac{\sum fx^2}{\sum f} - \left[ \frac{\sum fx}{\sum f} \right]^2$
Standard Deviation	$s = \sqrt{variance}$	

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

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	$x_0 = \frac{1}{y_2 - y_1} \begin{vmatrix} x_1 & y_1 \\ x_2 & y_2 \end{vmatrix}$	

SOLUTION FOR 1 <sup>st</sup> ORDER DIFFERENTIAL EQUATION	
<b>Logarithmic</b> $a = e^{\ln a}$ $a^x = e^{x \ln a}$ $\int a^x dx = \frac{a^x}{\ln a} + c$	<b>Homogeneous Equation</b> $y = vx$ and $\frac{dy}{dx} = v + x \frac{dv}{dx}$
	<b>Linear Factors (Integrating Factors)</b> $\frac{dy}{dx} + Py = Q$ $y \cdot IF = \int Q \cdot IF dx$ Where $IF = e^{\int P dx}$
GENERAL SOLUTION FOR 2 <sup>nd</sup> ORDER DIFFERENTIAL EQUATION	
Equation of the form	$a \frac{d^2 y}{dx^2} + b \frac{dy}{dx} + cy = 0$
Quadratics Formula	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
1. Real & different roots	$y = Ae^{m_1 x} + Be^{m_2 x}$
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. $\frac{d}{dx}(k) = 0, \quad k \text{ is constant}$	2. $\frac{d}{dx}(ax^n) = anx^{n-1} \quad [\text{Power Rule}]$
3. $\frac{d}{dx}(f(x) \pm g(x)) = f'(x) \pm g'(x)$	4. $\frac{d}{dx}(uv) = u \frac{dv}{dx} + v \frac{du}{dx} \quad [\text{Product Rule}]$
5. $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2} \quad [\text{Quotient Rule}]$	6. $\frac{dy}{dx} = \frac{du}{dx} \times \frac{dy}{du} \quad [\text{Chain Rule}]$
7. $\frac{d}{dx}(e^x) = e^x$	8. $\frac{d}{dx}(e^{ax+b}) = e^{ax+b} \times \frac{d}{dx}(ax + b)$
9. $\frac{d}{dx}(\ln  x ) = \frac{1}{x}$	10. $\frac{d}{dx}[\ln  ax + b ] = \frac{1}{ax + b} \times \frac{d}{dx}(ax + b)$
11. $\frac{d}{dx}(\sin x) = \cos x$	12. $\frac{d}{dx}(\cos x) = -\sin x$
13. $\frac{d}{dx}(\tan x) = \sec^2 x$	14. $\frac{d}{dx}[\sin(ax + b)] = \cos(ax + b) \times \frac{d}{dx}(ax + b)$
15. $\frac{d}{dx}[\cos(ax + b)] = -\sin(ax + b) \times \frac{d}{dx}(ax + b)$	16. $\frac{d}{dx}[\tan(ax + b)] = \sec^2(ax + b) \times \frac{d}{dx}(ax + b)$
17. $\frac{d}{dx}[\sin^n u] = n \sin^{n-1} u \times \cos u \times \frac{du}{dx}$	18. $\frac{d}{dx}[\cos^n u] = n \cos^{n-1} u \times -\sin u \times \frac{du}{dx}$
19. $\frac{d}{dx}[\tan^n u] = n \tan^{n-1} u \times \sec^2 u \times \frac{du}{dx}$	

### INTEGRATION

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