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)

Kertas ini mengandungi **SEMBILAN (9)** 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 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) / *Ketinggian (cm)*	Frequency / *Kekerapan*
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. $\frac{dy}{dx} = 7x^2 + 3 - \sin x$; Direct Integration

[5 marks]

[5 *markah*]

ii. $5e^x \frac{dy}{dx} = y$; 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)*

Textile	***Dye Stock (kg)***		
	Dye A	***Dye B***	***Dye C***
M	*7*	*4*	*6*
N	*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	*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	$D_k = L_{D_k} + \left(\frac{\frac{kN}{10} - F}{f_{D_k}}\right) C; \quad k = 1, 2, 3 \ldots 9$	
Percentile	$P_k = L_{P_k} + \left(\frac{\frac{kN}{100} - F}{f_{P_k}}\right) C; \quad k = 1, 2, 3 \ldots 99$	
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	$s = \sqrt{variance}$	

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

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	$x_{n+1} = x_n - \dfrac{f(x_n)}{f'(x_n)}$	
False Position Method	$x_0 = \dfrac{1}{y_2 - y_1} \begin{vmatrix} x_1 & y_1 \\ x_2 & y_2 \end{vmatrix}$	

SOLUTION FOR 1st ORDER DIFFERENTIAL EQUATION	
Logarithmic $a = e^{\ln a}$ $a^x = e^{x \ln a}$ $\int a^x \, dx = \dfrac{a^x}{\ln a} + c$	**Homogeneous Equation** $y = vx$ and $\dfrac{dy}{dx} = v + x\dfrac{dv}{dx}$ **Linear Factors (Integrating Factors)** $\dfrac{dy}{dx} + Py = Q$ $y \cdot IF = \int Q \cdot IF \, dx$ Where $IF = e^{\int P \, dx}$
GENERAL SOLUTION FOR 2nd ORDER DIFFERENTIAL EQUATION	
Equation of the form	$a\dfrac{d^2y}{dx^2} + b\dfrac{dy}{dx} + cy = 0$
Quadratics Formula	$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
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.	$\frac{d}{dx}(ax^n) = anx^{n-1}\quad [Power\ Rule]$
3.	$\frac{d}{dx}\big(f(x) \pm g(x)\big) = f'(x) \pm g'(x)$	4.	$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}\quad [Product\ Rule]$
5.	$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}\quad [Quotient\ Rule]$	6.	$\frac{dy}{dx} = \frac{du}{dx} \times \frac{dy}{du}\quad [Chain\ Rule]$
7.	$\frac{d}{dx}(e^x) = e^x$	8.	$\frac{d}{dx}\left(e^{ax+b}\right) = e^{ax+b} \times \frac{d}{dx}(ax+b)$
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.	$\int (ax+b)^n dx = \frac{(ax+b)^{n+1}}{(a)(n+1)} + c\ ;\{n \neq -1\}$
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.	$\int sec^2(ax+b)\ dx = \frac{1}{a} \times \tan(ax+b) + c$		