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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	TECHNICAL MATHEMATICS I
COURSE CODE	:	DAS 11003
PROGRAMME CODE	:	DAK
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**. 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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Q1 (a) Given $A = \begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & k \end{bmatrix}$.

(i) Find the value of k if $|A| = 1$.

(3 marks)

(ii) Find the inverse of matrix using formula of $A^{-1} = \dfrac{1}{|A|} Adj(A)$.

(7 marks)

(b) Given $\begin{bmatrix} 1 & 3 & 1 \\ 1 & -2 & -1 \\ 2 & 1 & 2 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ -3 \\ 5 \end{bmatrix}$. Use Gauss-Jordan Elimination Method to solve the following system for x, y and z. Do this following operation in order:

$$R_2 - R_1, R_3 - 2R_2, R_2 \Leftrightarrow R_3, R_3 - R_2, \frac{R_2}{-5}, \frac{R_3}{-2}, R_1 - 3R_2, R_1 - R_3$$

(10 marks)

Q2 (a) Solve $81^{9x+5} = 27^{7-2x}$ to find the value of x.

(4 marks)

(b) Determine the value of x for $\log_2 x + \log_4 x + \log_{16} x = 7$.

(5 marks)

(c) Simplify the expression of $\dfrac{\sqrt[3]{54x^3y^5}}{\sqrt[3]{16x^2y^2}}$.

(5 marks)

(d) Rationalize the denominator of $\dfrac{2\sqrt{3} - \sqrt{5}}{2\sqrt{2} + 3\sqrt{3}}$.

(6 marks)

Q3 (a) Solve $4m^2 - 15m = -10$ to find the value of m.

(4 marks)

(b) Solve the inequality $\dfrac{x(3-x)}{x-12} \geq 0$.

(7 marks)

(c) Express $\dfrac{x^2 - 3x}{(x+1)(x-2)}$ as partial fraction.

(9 marks)

Q4 (a) Given $\theta = 30°$, verify that $3\sin\theta - 4\sin^3\theta = \sin 3\theta$.

(4 marks)

(b) Find the value x in $4\sin^2 x + 8\cos x - 7 = 0$.

(5 marks)

(c) By using half angle formula, determine the value of $\tan\dfrac{\pi}{12}$ without using calculator.

(3 marks)

(d) Given $2\sin\theta - 5\cos\theta = r\sin(\theta + \alpha)$ and $0^\circ \le \theta \le 360^\circ$.

(i) Determine r and α.

(4 marks)

(ii) Thus, estimate the value of θ if $2\sin\theta - 5\cos\theta = 0$.

(4 marks)

Q5 (a) Calculate the sum of the series $9 + (-3) + 1 + (-\frac{1}{3}) + ... + (-\frac{1}{243})$.

(6 marks)

(b) A salesperson at home builder receive a salary plus commission for the first house sold is RM2500. For each additional home sold, she receive RM1000. Calculate the amount of the salary that she received if she sells 6 houses.

(5 marks)

(c) Find the sum of sequence $\sum_{k=1}^{7}(-7k + 4k^2 + k^3)$.

(5 marks)

(d) Given $(3 - 2x)^5$, expand in ascending powers of x, up to the term x^3.

(4 marks)

– END OF QUESTIONS –

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FORMULA

Polynomials

$$\log_a x = \frac{\log_a x}{\log_a b} \qquad a^3 - b^3 = (a-b)(a^2+ab+b^2) \qquad a^3 + b^3 = (a+b)(a^2-ab+b^2)$$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}, \qquad x^2+bx+c = \left(x+\frac{b}{2}\right)^2 - \left(\frac{b}{2}\right)^2 + c, \qquad x_{i+2} = \frac{x_i f(x_{i+1}) - x_{i+1} f(x_i)}{f(x_{i+1}) - f(x_i)}$$

Sequence and Series

$$\sum_{k=1}^{n} c = cn, \qquad \sum_{k=1}^{n} k = \frac{n(n+1)}{2}, \qquad \sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}, \qquad \sum_{k=1}^{n} k^3 = \left(\frac{n(n+1)}{2}\right)^2$$

$$u_n = a+(n-1)d \qquad S_n = \frac{n}{2}[2a+(n-1)d], \qquad S_n = \frac{n}{2}(a+u_n)$$

$$u_n = ar^{n-1}, \qquad S_n = \frac{a(r^n-1)}{r-1}, r>1 \textbf{ OR } S_n = \frac{a(1-r^n)}{1-r}, r<1, \qquad S_\infty = \frac{a}{1-r}.$$

$$u_n = S_n - S_{n-1}$$

$$(1+b)^n = 1 + nb + \frac{n(n-1)}{2!}b^2 + \frac{n(n-1)(n-2)}{3!}b^3 + \ldots\ldots$$

$$(x+y)^n = \binom{n}{0}x^n + \binom{n}{1}x^{n-1}y + \binom{n}{2}x^{n-2}y^2 + \ldots + \binom{n}{n-1}x^1y^{n-1} + \binom{n}{n}y^n$$

Trigonometry

$$\sin^2 x + \cos^2 x = 1, \qquad \tan^2 x + 1 = \sec^2 x, \qquad 1 + \cot^2 x = \csc^2 x$$

$$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta \qquad \cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$$

$$\tan(\alpha \pm \beta) = \frac{\tan\alpha \pm \tan\beta}{1 \mp \tan\alpha\tan\beta} \qquad \tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta}$$

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FORMULA

$$\sin 2\theta = 2\sin\theta\cos\theta, \quad \cos 2\theta = \cos^2\theta - \sin^2\theta$$
$$= 2\cos^2\theta - 1$$
$$= 1 - 2\sin^2$$

$$\sin\frac{\theta}{2} = \pm\sqrt{\frac{1-\cos\theta}{2}}, \quad \cos\frac{\theta}{2} = \pm\sqrt{\frac{1+\cos\theta}{2}}, \quad \tan\frac{\theta}{2} = \pm\sqrt{\frac{1-\cos\theta}{1+\cos\theta}}$$

$a\sin\theta + b\cos\theta = r\sin(\theta+\alpha) = r(\sin\theta\cos\alpha + \cos\theta\sin\alpha) = (r\cos\alpha)\sin\theta + (r\sin\alpha)\cos\theta$ and

$a = r\cos\alpha$ and $b = r\sin\alpha$

$$x_1^{(k+1)} = \frac{b_1 - a_{12}x_2^{(k)} - a_{13}x_3^{(k)}}{a_{11}}, \quad x_2^{(k+1)} = \frac{b_2 - a_{21}x_1^{(k+1)} - a_{23}x_3^{(k)}}{a_{22}}, \quad x_3^{(k+1)} = \frac{b_3 - a_{31}x_1^{(k+1)} - a_{32}x_2^{(k+1)}}{a_{33}}$$

Matrices

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}, \ |A| = a_{11}\begin{vmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{vmatrix} - a_{12}\begin{vmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{vmatrix} + a_{13}\begin{vmatrix} a_{21} & a_{22} \\ a_{31} & a_{32} \end{vmatrix}$$