FINAL

ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**April 2022**
Programme	:	Diploma In Mechanical Engineering (DMEN) Diploma In Electrical and Electronic (DEEI)
Course	:	**MAT1123 : Engineering Mathematics 3**
Date of Examination	:	August 5,2022 (Friday)
Time	:	4:00 pm – 6:30 pm Reading Time : Nil
Duration	:	2 hours 30 mins

Special Instructions :

This paper consists of **FOUR (4)** questions. Answer **ALL** the questions. **Write ALL your answers** on A4 paper.

Material permitted :

Non-Programmable Calculator

Materials provided :

Nil

Examiner(s)	:	**Mr Teow Hsien Loong** and Dr Nurulanati Othman
Chief Moderator	:	Mr Phua Chin Lai

*This paper consists of **3** printed pages, including the cover page*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME (DEEI)
MAT1123/MAT1136: ENGINEERING MATHEMATICS 3
FINAL ALTERNATIVE ASSESSMENT: APRIL 2022 SESSION

Instructions: This paper consists of **FOUR (4)** questions. All questions carry equal marks. Working must be shown.

Question 1

(a) Let the vectors $\mathbf{A} = 2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$, $\mathbf{B} = -3\mathbf{i} + 4\mathbf{j} - 5\mathbf{k}$, $C = 4\mathbf{i} - 5\mathbf{j} + 6\mathbf{k}$, use vector algebra to;

(i) Compute the angle between **A** and **B**,
(5 marks)

(ii) Verify whether **B** is perpendicular to **C**,
(4 marks)

(iii) Construct a vector parallel to **C** with magnitude 3 units,
(3 marks)

(iv) Construct a vector orthogonal to **A** and **C** with magnitude 5 units,
(4 marks)

(v) Computer the area of a parallelogram with sides of **A** and **B**.
(4 marks)

(b) Given that the position vector of a particle is $\mathbf{r} = \cos t\,\mathbf{i} + \sin t\,\mathbf{j} + t\,\mathbf{k}$ at time t, compute its velocity, acceleration and their respective magnitudes.
(5 marks)

Question 2

(a) Construct the equation of the tangent plane to the paraboloid $z = \frac{x^2+4y^2}{10}$ at the point $(2, -2, 2)$.
(12 marks)

(b) A region is bounded by the curve $x^2 + y^2 = 36$, lines $y = x$ and $y = 0$ in the first quadrant.

(i) Sketch and shade, the region bounded by the curve $x^2 + y^2 = 36$, lines $y = x$ and $y = 0$, in the first quadrant. Label all the boundaries and intersection points.
(4 marks)

(ii) Construct a double integral to evaluate the shaded region in part(b)(i)
(3 marks)

(iii) Hence, assess the double integral in part(b)(ii) using polar coordinates system.
(6 marks)

Question 3

Using Gauss' Divergence Theorem, compute the work done by force field $\mathbf{F} = x^2\mathbf{i} + z\mathbf{j} + y\mathbf{k}$ on the solid bounded by the planes $z = 0$, $z = 2$, $x = 0$, $x = 1$, $y = 0$, $y = 3$.

(25 marks)

Question 4

The following periodic function, *f(x)* has a period of 2π.

$$f(x) = \begin{cases} 0, & -\pi < x < 0 \\ 1, & 0 < x < \pi \end{cases}$$

(a) Sketch and label the graph of function *f(x)* for $-3\pi \leq x \leq 3\pi$.

(3 marks)

(b) Construct the Fourier series for the periodic function *f(x)* up to fifth harmonic.

(22 marks)

If f(x) is defined in the range –L to L (ie. has a period of 2L), its Fourier series is:

$$f(x) = \frac{1}{2}a_0 + \sum_{n=1}^{\infty}\left(a_n \cos\frac{n\pi x}{L} + b_n \sin\frac{n\pi x}{L}\right)$$

where $a_0 = \frac{1}{L}\int_{-L}^{L} f(x)\,dx$; $a_n = \frac{1}{L}\int_{-L}^{L} f(x)\cos\frac{n\pi x}{L}\,dx$; $b_n = \frac{1}{L}\int_{-L}^{L} f(x)\sin\frac{n\pi x}{L}\,dx$

-THE END-