INTI International University & Colleges

FINAL
ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**August 2021**
Programme	:	Diploma in Electrical & Electronic Engineering (DEEI) Diploma in Mechanical Engineering (DMEN)
Course	:	**MAT1123/MAT1136: Engineering Mathematics 3**
Date of Examination	:	7 December 2021 (Tuesday)
Time	:	4.00pm – 6.30pm Reading Time : Nil
Duration	:	2 Hours 30 Minutes

Special Instructions :

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

Material permitted	:	Non-Programmable Scientific Calculator
Materials provided	:	Mathematics Formulae Booklet

Examiner(s)	:	**Dr Nurulanati Othman**
Chief Moderator	:	Teow Hsien Loong

*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 EXAMINATION: AUGUST 2021 SESSION

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Question 1

(a) The following lines lie on a plane: $L_1: x = 4t + 2,\ y = 2t - 6,\ z = 6t + 4$ and $L_2: x = 10s,\ y = 4s - 6,\ z = 6s + 10$.

(i) Compute the angle between L_1 and L_2, giving your answer to one decimal place in degrees.

(7 marks)

(ii) If $t = 0$, compute the plane equation that contains L_1 and L_2.

(8 marks)

(b) Let $\vec{\boldsymbol{r}} = (3\cos 2t)\hat{\boldsymbol{\imath}} + (4\sin t)\hat{\boldsymbol{\jmath}} + (5e^t + 1)\hat{\boldsymbol{k}}$ be the position vector of a moving particle, where $t \geq 0$ is time. Compute the velocity vector, speed and acceleration vector at the point $Q(3, 0, 6)$.

(10 marks)

Question 2

(a) Given a scalar field $\phi = xye^z + 3$ and a vector $\vec{\mathbf{v}} = -\hat{\mathbf{i}} - 3\hat{\mathbf{j}} + \hat{\mathbf{k}}$, find, at the point $P(1, 2, 1)$, the directional derivative of ϕ in the direction of $\vec{\mathbf{v}}$. Hence, justify with reason whether there will be an increase, decrease or no change in ϕ.

(10 marks)

(b)

(i) Sketch and shade, in the same diagram, the region bounded by the curve $x^2 + y^2 = 16$, lines $y = x$ and $x = 0$, in the first quadrant. Label all the boundaries and intersection points.

(4 marks)

(ii) Construct a double integral in $dy\,dx$ order to evaluate the shaded region in part(b)(i).

(5 marks)

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

(6 marks)

Question 3

(a) Solve the line integral $\int_C x\,dx - z^2 dy + yz\,dz$ along the curve C given by $x = t$, $y = \cos t$ and $z = \sin t$, where $0 \leq t \leq \frac{\pi}{4}$. Leave your answer in four (4) decimal places.

(10 marks)

(b) Given that $\vec{\mathbf{F}} = x\hat{\mathbf{i}} + y\hat{\mathbf{j}} + 2z^2\hat{\mathbf{k}}$, find the divergence of $\vec{\mathbf{F}}$. Hence, use the Divergence Theorem to compute $\iint_S \vec{\mathbf{F}}.\mathrm{d}S$ where S is the surface enclosed by paraboloid $z = x^2 + y^2$ and the plane $z = 1$.

(15 marks)

Question 4

Given a periodic function,

$$f(t) = \begin{cases} -\frac{1}{2} & -\pi < t \leq 0 \\ \frac{1}{2} & 0 < t < \pi \end{cases}$$

$$f(t) = f(t + 2\pi)$$

(a) Sketch the graph $f(t)$ over the interval $-2\pi \leq t \leq 2\pi$. Based on the graph, state with reason whether $f(t)$ is an odd or even function (or neither).

(5 marks)

(b) Hence, show that the Fourier series for $f(t)$ in the interval $-\pi < t < \pi$ is

$$f(t) = \frac{2}{\pi}\sin t + \frac{2}{3\pi}\sin 3t + \frac{2}{5\pi}\sin 5t + \cdots$$

(20 marks)

-THE END-