INTI International University & Colleges

RESIT

ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**January 2022**
Programme	:	Diploma In Mechanical Engineering (DMEN)
Course	:	**MAT1123 : Engineering Mathematics 3**
Date of Examination	:	5th March 2022 (Saturday)
Time	:	8:00am – 10:30am 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.

Note: 30 minutes is added into the duration of the examination to factor in any connectivity matters and for you to scan and upload your scripts.

Material permitted : Non-Programmable Calculator

Materials provided : Nil

Examiner(s)	:	**Dr Chan Kah Yein**
Chief Moderator	:	Dr Nurulanati Binti Othman

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

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
MAT1123 : ENGINEERING MATHEMATICS 3
RESIT ALTERNATIVE ASSESSMENT : JANUARY 2022 SESSION

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

Question 1

(a) Find the equation of the plane that passes through the point P(1, 5, – 4) and is perpendicular to the line $\frac{x-5}{4} = \frac{y-3}{6} = \frac{z+1}{-2}$.

(6 marks)

(b) Find the angle between the line L: $x = 2t + 1, y = 5 - t, z = 2t$ and the plane P: $x + 5y - 3z = 0$. Give your answer correct to 1 decimal place in degrees.

(9 marks)

(c) Let $\vec{\mathbf{r}} = (3\cos t)\,\hat{\mathbf{i}} + (2\sin 3t)\,\hat{\mathbf{j}} + (\cos 2t)\,\hat{\mathbf{k}}$ be the position vector of a moving particle, where $0 \le t \le 2\pi$ is time. Find the velocity and acceleration vectors at the point Q(–3, 0, 1).

(10 marks)

Question 2

(a) Given a scalar field $\phi = x^2y + yz^3 - 2xz$ and a vector $\vec{\mathbf{A}} = 2\hat{\mathbf{i}} - \hat{\mathbf{j}} + 4\hat{\mathbf{k}}$, find, at the point $(1, 1, -2)$, the directional derivative of ϕ in the direction of $\vec{\mathbf{A}}$.

(9 marks)

(b) Given that a line integral, $\mathbf{I} = \int_C [(xy^2 + y^3)\,dx + (x^2y + 3xy^2)\,dy]$. Determine if **I** is independent of the path of integration.

(6 marks)

(c) Evaluate the double integral $\iint_R x\,dydx$ where R is the region bounded by the straight line $y = x$ and the curve $y = \sqrt{x}$.

(10 marks)

Question 3

(a) Evaluate $\oint_C \vec{\mathbf{F}} \cdot d\vec{\mathbf{r}}$ where $\vec{\mathbf{F}} = (2z)\,\hat{\mathbf{i}} + (x)\,\hat{\mathbf{j}} + (y^2)\,\hat{\mathbf{k}}$ and C is the cross section of the paraboloid $z = 16 - x^2 - y^2$ with the xy-plane. Assume a counter-clockwise orientation as viewed from above. Use line integration and Stoke's Theorem.

(20 marks)

(b) Set up a double integral with correct limits to evaluate the area of the region bounded by the curve $y = x^2$ and the lines $x + 2y = 6$ and $y = 0$ in the first quadrant.

(5 marks)

Question 4

(a) A periodic function whose period is 2π is defined by $g(x) = x \cos x, -\pi < x < \pi$. State whether g(x) is an odd or even function (or neither) and explain your answer.

(5 marks)

b) Obtain the Fourier Series up to the fourth harmonic for f(x), given that its period is 2π and it is defined by

$$f(x) = x^2, \quad -\pi < x < \pi,$$
$$f(x) = f(x + 2\pi).$$

(20 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-