FINAL
ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**August 2020**
Programme	:	Diploma in Electrical & Electronic Engineering (DEEI) Diploma in Mechanical Engineering (DMEN)
Course	:	**MAT1123/MAT1136: Engineering Mathematics 3**
Date of Examination	:	14 December 2020 (Monday)
Time	:	8.00am – 10.15am Reading Time : Nil
Duration	:	2 Hours 15 Minutes

Special Instructions :

This paper consists of **FOUR (4)** questions. Answer all questions in the answer booklet provided.
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	:	Dr Chan Kah Yein

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

DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING PROGRAMME (DEEI)
DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
MAT1123 / MAT1136: ENGINEERING MATHEMATICS 3
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2020 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer all questions in the answer booklet provided. All questions carry equal marks. Working must be shown.

Question 1

(a) Compute the determinant of the following matrix by cofactor expansions along the second row.

$$\begin{bmatrix} \mathbf{1} & \mathbf{0} & \mathbf{-2} & \mathbf{3} \\ \mathbf{3} & \mathbf{4} & \mathbf{-1} & \mathbf{0} \\ \mathbf{4} & \mathbf{5} & \mathbf{0} & \mathbf{2} \\ \mathbf{0} & \mathbf{1} & \mathbf{2} & \mathbf{1} \end{bmatrix}$$

(8 marks)

(b) Let matrix $\mathbf{A} = \begin{bmatrix} 1 & 2 & 5 \\ 0 & -5 & 0 \\ 4 & -2 & 0 \end{bmatrix}$.

(i) Find the eigenvalue(s) of **A**.

(4 marks)

(ii) Hence, find the eigenvector corresponding to the smallest eigenvalue.

(7 marks)

(c) Solve the following system of linear equations using Gauss-Seidel method. Complete two (2) iterations, starting with the initial guess $x_1^{(0)} = 1$, $x_2^{(0)} = 1$, $x_3^{(0)} = 1$, and keep 4 decimal places in all working.

$$\begin{aligned} 8x_1 - x_2 + 2x_3 &= 21 \\ 2x_1 - 11x_2 - x_3 &= 36 \\ x_1 - x_2 + 9x_3 &= 14 \end{aligned}$$

(6 marks)

Question 2

(a) Given three points $P(-1, 2, 1)$, $Q(0, -3, 2)$ and $R(1, 1, -4)$, find the following:

(i) Vectors $\overrightarrow{PQ}$ and $\overrightarrow{PR}$,

(2 marks)

(ii) A vector perpendicular to $\overrightarrow{PQ}$ and $\overrightarrow{PR}$,

(4 marks)

(iii) The angle between the plane consisting the points P, Q and R with the plane given by the equation $6x - 8y - 2z = 14$.

(7 marks)

(b) Consider the function $f(x,y) = x^2y + xy^2$ and a vector $\vec{\mathbf{A}} = 3\hat{\mathbf{i}} + 4\hat{\mathbf{j}}$. Find at the point $(-1, 2)$,

(i) the gradient of f,

(3 marks)

(ii) the unit vector in the direction of $\vec{\mathbf{A}}$,

(2 marks)

(iii) the directional derivative of f in the direction of $\vec{\mathbf{A}}$.

(2 marks)

(c) Set up a double integral with the correct limits to evaluate the area of the region bounded by the curve $y = x^2$ and the lines $y = 8 + 2x$ and $x = 0$ in the second quadrant.

(5 marks)

Question 3

(a) Use line integration to evaluate

$$\oint_C \mathbf{F} \cdot \mathrm{d}\mathbf{r}$$

where $\mathbf{F} = y\boldsymbol{i} + z\boldsymbol{k}$ and C is the circle in which the hemisphere $x^2 + y^2 + z^2 = 1$ intercepts the plane $z = 0$.

(13 marks)

(b) Using the Divergence Theorem, find $\iint_S \mathbf{F}.\mathrm{d}S$ where $\mathbf{F} = y\mathbf{i} + x\mathbf{j} + z^2\boldsymbol{k}$ and S is the surface enclosed by paraboloid $z = x^2 + y^2$ and the plane $z = 1$.

(12 marks)

Question 4

Given a periodic function $f(t) = t$, for $-1 < t < 1$ and $f(t) = f(t + 2)$,

(a) sketch the function $f(t)$ for $-3 < t < 3$ and hence, explain whether $f(t)$ is odd, even or neither.

(6 marks)

(b) identify the period, T, and calculate the angular frequency, ω, for the periodic function $f(t)$.

(3 marks)

(c) determine the Fourier series for the periodic function $f(t)$ up to the sixth harmonic.

(16 marks)

~THE END~