INTI
International College Penang

FINAL
Examination Paper

(COVER PAGE)

Session	:	**April 2019**
Programme	:	Diploma in Electrical and Electronic Engineering (DEEI)
Course	:	**MAT 1136: Engineering Mathematics 3**
Date of Examination	:	1 August 2019 (Thursday)
Time	:	11:00am – 1:00pm Reading Time : Nil
Duration	:	2 Hours
Special Instructions	:	

This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Non-programmable calculator

Materials provided :

Formula Booklet 1

Examiner(s)	:	**Chan Ah Wah**
Moderator	:	Dr. Ch'ng Pei Eng

This paper consists of ***5*** printed pages, including the cover page.

INTI INTERNATIONAL COLLEGE PENANG
DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)
MAT1136: ENGINEERING MATHEMATICS 3
FINAL EXAMINATION : APRIL 2019 SESSION

Instructions

This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Given the following system of linear equations:

$$\begin{aligned} 2x + \ y - 5z &= 6 \\ x - 3y + 2z &= 9 \\ 3x - \ y + 4z &= 5 \end{aligned}$$

(i) Solve the linear system using Gauss-Jordan method.

[8 marks]

(ii) Verify your answer for y in part(i) using Cramer's rule.

[4 marks]

(b) Given a 2×2 matrix $\mathbf{A} = \begin{bmatrix} 5 & 4 \\ 3 & 1 \end{bmatrix}$.

(i) Find the eigenvalues of **A**.

[3 marks]

(ii) Find an eigenvector corresponding to each of the eigenvalues.

[6 marks]

(c) Suppose **A** and **B** are both 3×3 matrices such that $\det(\mathbf{A}) = 2$ and $\det(\mathbf{B}) = 4$. Find $\det(3\mathbf{A}\mathbf{B}^{-1})$.

[4 marks]

Question 2

(a) Apply Gauss-Seidel scheme to solve the following system. Complete two (2) iterations starting with the initial guess

$$x_1^{(0)} = 1, \ x_2^{(0)} = 1, \ x_3^{(0)} = 1.$$

Maintain 4 decimal places throughout the calculations.

$$\begin{aligned} 10x_1 - \ x_2 + \ x_3 &= 21 \\ x_1 + 9x_2 - \ x_3 &= 25 \\ -x_1 + \ x_2 + 8x_3 &= 33 \end{aligned}$$

[5 marks]

(b) Let $\mathbf{A} = \begin{bmatrix} 3 & 0 & -2 \\ 2 & 2 & -4 \\ -4 & 5 & -5 \end{bmatrix}$ and $\mathbf{P} = \begin{bmatrix} 1 & 1 & 2 \\ 2 & 2 & 3 \\ 1 & 3 & 1 \end{bmatrix}$.

(i) Find $\mathbf{P}^{-1}$, the inverse of $\mathbf{P}$, using adjoint method.

[6 marks]

(ii) Show that $\mathbf{P}^{-1}\mathbf{AP}$ is a diagonal matrix.

[4 marks]

(c) Let $\mathbf{A} = 2\mathbf{i} + \alpha\mathbf{j} + 3\mathbf{k}$, $\mathbf{B} = 3\mathbf{i} - 2\mathbf{j} + \mathbf{k}$, and $\mathbf{C} = 4\mathbf{i} + 3\mathbf{j} - 2\mathbf{k}$.

(i) Find the value of α if $\mathbf{A}$ is perpendicular to $\mathbf{B}$.

[4 marks]

(ii) Evaluate $|\mathbf{B} \times \mathbf{C}|$ and interpret the value obtained geometrically.

[6 marks]

Question 3

(a) Given three points $P(-1,2,1)$, $Q(2,-2,3)$, and $R(3,1,-3)$.

(i) Find the vectors $\overrightarrow{PQ}$ and $\overrightarrow{PR}$.

[3 marks]

(ii) Find a vector perpendicular to both vectors $\overrightarrow{PQ}$ and $\overrightarrow{PR}$. Hence, find the equation of the plane through the points P, Q and R.

[5 marks]

(b) Given a scalar field $\phi = x^2y + yz^3 - 3xz$ and a vector $\mathbf{A} = 2\mathbf{i} - \mathbf{j} - 2\mathbf{k}$. Find, at the point $(1,1,-2)$,

(i) the gradient of ϕ,

[3 marks]

(ii) the unit vector in the direction of **A**.

[2 marks]

(iii) the directional derivative of ϕ in the direction of **A**.

[2 marks]

(c) Use Green's theorem to evaluate

$$\oint_C (x+3y)\,dx + (x^2+xy)\,dy$$

where C is the boundary of the region R bounded by $y = x$, $y = 1$ and $x = 0$ in the counterclockwise direction.

[10 marks]

Question 4

(a) Evaluate, using Stokes' theorem, $\iint_S \nabla \times \mathbf{F} \bullet d\mathbf{S}$ where

$$\mathbf{F} = -y\mathbf{i} + 2xz\mathbf{j} + \mathbf{k}$$

and C is the boundary of the circle $x^2 + y^2 = 3$ on the xy-plane in a counter-clockwise direction.

[12 marks]

(b) Use Gauss's divergence theorem to evaluate $\iint_S \mathbf{F} \cdot d\mathbf{S}$ where $\mathbf{F} = 3xyz\mathbf{i} + 4y^2z\mathbf{j} + 2yz^2\mathbf{k}$ and S is the surface of the cube bounded by the planes $x = 0$, $x = 1$, $y = 0$, $y = 1$, $z = 0$, and $z = 1$.

[13 marks]

Question 5

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

[7 marks]

(b) A periodic function $f(x)$ is given by

$$f(x) = 2x, \text{ for } 0 < x < 2\pi$$
$$f(x) = f(x + 2\pi).$$

(i) Sketch the graph of $f(x)$ for $-4\pi < x < 4\pi$.

[3 marks]

(ii) Compute a_0 where $a_0 = \dfrac{1}{\pi}\displaystyle\int_0^{2\pi} f(x)dx.$

[3 marks]

(iii) Compute a_n where $a_n = \dfrac{1}{\pi}\displaystyle\int_0^{2\pi} f(x)\cos(nx)dx.$

[5 marks]

(iv) Compute b_n where $b_n = \dfrac{1}{\pi}\displaystyle\int_0^{2\pi} f(x)\sin(nx)dx.$

Hence, find the terms in the Fourier series representation as far as $\sin(4x)$ / $\cos(4x)$.

[7 marks]

End of Paper

<MAT1136(F)/APR2019/CHANAW>