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FINAL
Examination Paper

(COVER PAGE)

Session	:	**August 2018**
Programme	:	Diploma in Electrical and Electronic Engineering (DEEI)
Course	:	**MAT 1136: Engineering Mathematics 3**
Date of Examination	:	13 December 2018 (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)	:	**Mr. Chan Ah Wah**
Moderator	:	Dr. Ch'ng Pei Eng

This paper consists of *4* printed pages, including the cover page.

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)

MAT1136 : ENGINEERING MATHEMATICS 3

FINAL EXAMINATION : AUGUST 2018 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) Use elementary row operations to solve the system below. Leave your answer in vector form.

$$\begin{aligned} x_1 - 2x_2 + 3x_3 + x_4 &= -3 \\ 2x_1 - x_2 + 3x_3 - x_4 &= 0 \end{aligned}$$

[8 marks]

(b) Given a 2×2 matrix $\mathbf{A} = \begin{bmatrix} 5 & 6 \\ 2 & 1 \end{bmatrix}$.

(i) Find the eigenvalues of $\mathbf{A}$.

[4 marks]

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

[7 marks]

(c) Consider the following system of linear equations.

$$\begin{aligned} -8x + y + z &= 1 \\ x - 5y + z &= 16 \\ x + y - 4z &= 7 \end{aligned}$$

(i) Set up a Gauss-Seidel scheme for the system.

[3 marks]

(ii) Compute one (1) iteration, starting with inital guess $x = 1,\ y = 1,\ z = 1$. Keep 4 decimal places in all calculations.

[3 marks]

Question 2

(a) A plane contains the points $A(1,1,1)$, $B(2,0,1)$ and $C(3,2,0)$.

(i) Find the vectors $\overrightarrow{\mathbf{AB}}$ and $\overrightarrow{\mathbf{AC}}$.

[2 marks]

(ii) Find a normal vector to the plane containing A, B and C.

[4 marks]

(iii) Find the equation of the plane containing the points A, B and C.

[5 marks]

(b) Let **I** be the line integral $\mathbf{I} = \int_C (6x^2 + 4y^2 + 5y)dx + (8xy - 2y^2 + 5x)dy$.

(i) Show that **I** is independent of path.

[5 marks]

(ii) Find the scalar potential $\phi(x,y)$ and hence, evaluate **I**, if C is a simple path joining the points $(0,0)$ and $(1,1)$ in the xy-plane.

[9 marks]

Question 3

(a) Evaluate the line integral $\oint_C xydx + (x^2 + y)dy$ where C is the triangular path OAB defined by $O(0,0)$, $A(1,1)$ and $B(0,1)$ in the counter-clockwise direction, using

(i) Green's theorem,

[8 marks]

(ii) line integrations.

[11 marks]

(b) Given that $f = x^2z - 2xy^2 + yz^2$ and $\overrightarrow{\mathbf{V}} = \mathbf{i} + \mathbf{j} + \mathbf{k}$, find the directional derivative of f in the direction of $\overrightarrow{\mathbf{V}}$ at the point $(1,2,1)$.

[6 marks]

Question 4

(a) Use Gauss's divergence theorem to evaluate $\iint_S \mathbf{F} \bullet d\mathbf{S}$ where $\mathbf{F} = 2x\mathbf{i} + y^2\mathbf{j} - 3z\mathbf{k}$ and S is the surface of the solid completely enclosed by the cylinder $x^2 + y^2 = 1$ and the planes $z = 0$ and $z = 2$.

[16 marks]

(b) Set up integrals with correct limits to evaluate the area of the following regions. Do not integrate.

(i) The region, expressed in polar coordinates, bounded by the circle $x^2 + y^2 = 1$ and the lines $y = x$ and $y = \frac{1}{\sqrt{3}}x$ in the first quadrant.

[4 marks]

(ii) The region, expressed in Cartesian coordinates, bounded by the curve $y = x^2$ and the lines $x + y = 2$ and $x = 0$ in the first quadrant.

[5 marks]

Question 5

(a) Use Stokes' theorem to evaluate $\oint_C \mathbf{F} \bullet d\mathbf{r}$ where $\mathbf{F} = y\mathbf{i} + 2xz\mathbf{j} + \mathbf{k}$ and C is the boundary of the circle $x^2 + y^2 = 2$ in a counter-clockwise direction.

[10 marks]

(b) Classify the following functions as either even, odd, or neither.

(i) $t^3 \sin 2t$

[1 mark]

(ii) $t \cos 2t$

[1 mark]

(iii) $\sin t \sin 3t$

[1 mark]

(iv) $e^t \cos t$

[1 mark]

(c) For the periodic function

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

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

(i) Sketch the graph of $f(t)$ over the interval $-2\pi \leq t \leq 2\pi$.

[3 marks]

(ii) Determine the infinite Fourier series of $f(t)$.

[8 marks]

End of Paper