INTI International College Penang

FINAL
Examination Paper

(COVER PAGE)

Session : **April 2018**

Programme : Diploma in Electrical and Electronic Engineering (DEEI)

Course : **MAT 1136: Engineering Mathematics 3**

Date of Examination : 31 July 2018 (Tuesday)

Time : 8:00am – 10:00am   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 4 printed pages, including the cover page.

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

$$x_1 + 2x_2 - x_3 + 4x_4 = 1$$
$$x_1 + x_2 + x_3 - 2x_4 = 2$$

[8 marks]

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

(i) Find the eigenvalues of **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.

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

(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 3 decimal places in all calculations.

[3 marks]

Question 2

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

(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 $\mathbf{I} = \int_C (x^2 + 3y^2 + 4y)dx + (6xy - 2y^2 + 4x)dy$.

(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 $\oint_C xydx + (x^2 + y^2)dy$ 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 $\overrightarrow{\mathbf{V}} = 2\mathbf{i} + 3\mathbf{j} - 4\mathbf{k}$, 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 $\mathbf{F} = x\mathbf{i} + 2y^2\mathbf{j} + 3z\mathbf{k}$ 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 $y = \sqrt{3}x$ in the first quadrant.

[4 marks]

(ii) The region, expressed in Cartesian coordinates, bounded by the curve $y = x^2$ and the lines $2x + y = 3$ 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 $\mathbf{F} = 2y\mathbf{i} + 3xz\mathbf{j} + \mathbf{k}$ and C is the boundary of the circle $x^2 + y^2 = 4$ in a counter-clockwise direction.

[10 marks]

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

(i) $t^3 \sin wt$ [1 mark]

(ii) $t \cos 2t$ [1 mark]

(iii) $\sin t \, \sin 4t$ [1 mark]

(iv) $e^t \sin t$ [1 mark]

(c) For the periodic function

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

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

(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