FINAL
Examination Paper

(COVER PAGE)

Session	:	**August 2019**
Programme	:	Diploma In Mechanical Engineering (DMEN)
Course	:	**MAT1122 : Engineering Mathematics 2**
Date of Examination	:	December 13, 2019 (Friday)
Time	:	11:00 am – 1:00 pm Reading Time: Nil
Duration	:	2 Hours
Special Instructions	:	

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

Materials permitted :

Non-Programmable Scientific Calculator

Materials provided :

Formula Booklet 1

Examiner (s)	:	**Dr Chan Kah Yein** and Bark Chee Beng
Moderator	:	Assoc Prof Chan Kait Loon

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

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
MAT1122 : ENGINEERING MATHEMATICS 2
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Question 1

(a) Evaluate $\frac{(3-2i)(1+i)}{(1-i)}$, giving your answer in rectangular form. (6 marks)

(b) Express $z = \sqrt{3} - i$ in polar form. Use De Moivre's Theorem to find the cube roots of z. Leave your answers in polar form. (10 marks)

(c) The deflection y at the centre of a certain rod is given by $y = \frac{2wx^3}{z^4}$ where w, x and z are variables. If w increases by 2%, x increases by 3%, and z decreases by 1%, find the percentage change in y by using partial derivatives. (9 marks)

Question 2

(a) Find the inverse of matrix $\mathbf{A} = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 4 & 9 \end{pmatrix}$ using the adjoint method. (14 marks)

(b) Solve the following system of linear equations using elementary row operations:

$$\begin{aligned} 2x - 2y + 2z &= 3 \\ 5x + y + 3z &= 10 \\ x + 2y + z &= 9 \end{aligned}$$

(11 marks)

Question 3

(a) Find the following integrals.

(i) $\int \frac{1}{2x\sqrt{\ln x}}\, dx$ (4 marks)

(ii) $\int x^2 e^{5x}\, dx$ (5 marks)

(iii) $\int \frac{1}{1+16x^2}\, dx$ (5 marks)

(iv) $\int \frac{13x+4}{10x^2+x-3}\, dx$ (6 marks)

(b) Derive Maclaurin series for $f(x) = \frac{1}{\sqrt{1-x}}$ up to the term in x^2. (5 marks)

Question 4

(a) Solve the following first-order differential equations. Write y as the subject for the final answers.

(i) $(1 + x^4)\frac{dy}{dx} = x^3 y$ (6 marks)

(ii) $\frac{dy}{dx} - \frac{y}{x} = \ln x$ (9 marks)

(b) Solve the following homogeneous second-order differential equations.

(i) $2\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 2y = 0$ (3 marks)

(ii) $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0$ (3 marks)

(iii) $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 5y = 0$ (4 marks)

Question 5

(a) Solve the second-order differential equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 3y = 3x^2$, using the method of undetermined coefficients. (11 marks)

(b) Solve the following differential equation using Laplace transform:
$\frac{d^2y}{dt^2} - 3\frac{dy}{dt} + 2y = e^{-3t}$, given that when $t = 0$, $y = 0$, $\frac{dy}{dt} = 1$. (14 marks)

Laplace transforms of differential coefficients

$L\{y\} = \bar{y}$; $L\{\frac{dy}{dt}\} = s\bar{y} - y_0$; $L\{\frac{d^2y}{dt^2}\} = s^2\bar{y} - sy_0 - y_1$ where y_0 is the value of y when $t = 0$,
y_1 is the value of $\frac{dy}{dt}$ when $t = 0$.

-THE END-