FINAL

ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**April 2020**
Programme	:	Diploma In Mechanical Engineering (DMEN) Diploma In Electrical and Electronic Engineering (DEEI)
Course	:	**MAT1122/MAT1135 : Engineering Mathematics 2**
Date of Examination	:	August 5, 2020 (Wednesday)
Time	:	12:00 pm – 2:15 pm Reading Time : Nil
Duration	:	2 hours 15 mins

Special Instructions :

Answer **ALL FOUR (4)** questions.

Material permitted :

Non-programmable calculator

Materials provided :

Nil

Examiner(s)	:	**Dr Chan Kah Yein** & Dr Nurulanati Binti Othman
Chief Moderator	:	Dr Chan Kah Yein

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

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING PROGRAMME (DEEI)
MAT1122/MAT1135 : ENGINEERING MATHEMATICS 2
FINAL ALTERNATIVE ASSESSMENT : APRIL 2020 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer **ALL** questions.
All questions carry equal marks. Complete working must be shown.

Question 1

(a) Express $z = -\sqrt{7} + \sqrt{7}i$ in polar form. Use De Moivre's Theorem to evaluate z^8, giving your answer in polar and rectangular forms.

(10 marks)

(b) Technician 1 spends a total of 13 hours to repair two type-X machines, three type-Y machines and four type-Z machines. Meanwhile, Technician 2 spends 17 hours to repair three type-X machines, four type-Y machines and five type-Z machines. In the meantime, Technician 3 manages to repair four type-X machines, one type-Y machine and one type-Z machine in 7 hours. Assuming the hours taken to repair each machine is the same for every technician, write a system of linear equations for these statements and a corresponding matrix equation for it. Use Gauss-Jordan Elimination to find the hours needed for repairing each of type-X, type-Y, and type-Z machines.

(15 marks)

Question 2

(a) The two sides of a triangle with the lengths x = 5 cm and y = 4 cm are increasing at the rate of 1 cm/s and 2 cm/s respectively while the included angle, $\theta = \pi/6$, is decreasing at the rate of $\frac{\sqrt{3}}{3}$ rad/s. Derive a chain rule to find the rate of change of the area of the triangle A by using partial derivatives. Hint: Area of triangle, $A = \frac{1}{2}xy \sin\theta$.

(8 marks)

(b) Find the following integrals.

(i) $\int \frac{1}{9x^2+16}\, dx$

(5 marks)

(ii) $\int \frac{28x-29}{6x^2-11x+4}\, dx$

(5 marks)

(c) Derive Maclaurin series for f(x) = cosh 2x up to the third non-zero term and use your series to estimate an answer for $\int \frac{\cosh 2x}{x}\, dx$.

(7 marks)

Question 3

(a) Solve the following first-order differential equations using an integrating factor. Write your answer with y as the subject.

$$\frac{dy}{dx} + \frac{y}{x} = e^{2x}$$

(8 marks)

(b) The rate of decay of a radioactive substance is proportional to the amount A remaining at any instant, where $\frac{dA}{dt} = kA$, t is time and k is a constant. If the time taken for the amount to become half is 700 years, solve the differential equation and find the time taken for the amount to become 15% of its original amount, correct to 1 decimal place.

(12 marks)

(c) Find the complementary function and write down the particular integral (without solving) for $\frac{d^2y}{dx^2} - 25y = e^{5x}$.

(5 marks)

Question 4

The equation of motion of a body performing damped forced vibrations is

$$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = \cos t$$

where y is the displacement from the equilibrium position and t is time. Solve the equation using

(a) the method of undetermined coefficients.

(12 marks)

(b) Laplace transform, given that when t = 0, y = 1 and $\frac{dy}{dt} = 0$.

(13 marks)

Laplace transforms of differential coefficients

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

-THE END-