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FINAL
Examination Paper

(COVER PAGE)

Session	:	**April 2016**
Programme	:	Diploma in Electrical and Electronic Engineering (DEEI)
Course	:	**MAT 1122: Engineering Mathematics 2**
Date of Examination	:	27 July 2016, Wednesday
Time	:	2.00pm – 4.00pm 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 **5** printed pages, including the cover page.

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)

MAT1122 ENGINEERING MATHEMATICS 2

FINAL EXAMINATION : APRIL 2016 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) Express the following in the form $\frac{a}{b} + i\frac{c}{d}$ where a, b, c, d are real numbers .

(i) $\frac{2+3i}{4-i}$

[3 marks]

(ii) $\frac{i}{1+i\sqrt{3}}$

[3 marks]

(b) Express $(1+i)^5$ in the form $a+ib$ using de Moivre's Theorem .

[5 marks]

(c) Find the three cube roots of i .

[7 marks]

(d) Use Euler's Method to solve for the values of y for $x = 0.0(0.1)0.4$ if

$$\frac{dy}{dx} = 7y + 2x^2, \quad y(0) = 5$$

Let all workings be correct to **four (4)** decimal places. The formula for the Method is given below :

$$\frac{dy}{dx} = f(x,y)$$
$$x_{n+1} = x_n + h$$
$$y_{n+1} = y_n + hf(x_n, y_n)$$

[7 marks]

Question 2

Evaluate the following integrals :

(a) $\displaystyle\int \frac{1}{1+2x^2}\,dx$

[5 marks]

(b) $\displaystyle\int x^2 \sin x\,dx$

[5 marks]

(c) $\displaystyle\int \frac{x^3+x+1}{x^4+x^2}\,dx$

[6 marks]

(d) $\displaystyle\int \sin^3 x\,dx$

[5 marks]

(e) $\displaystyle\int \frac{\ln x}{x}\,dx$

[4 marks]

Question 3

(a) Given that $z = e^{x+y}\sin\left(x^2y^3\right)$, find $\dfrac{\partial z}{\partial x}$ and $\dfrac{\partial z}{\partial y}$.

[6 marks]

(b) The coefficient of rigidity (G) of a wire of length L and uniform diameter M is given by

$$G = \frac{AL}{M^4}$$

where A is a constant. If errors of $\pm 0.25\%$ and $\pm 1\%$ are possible in measuring L and M respectively, determine the maximum percentage error in the calculated value of G .

[3 marks]

(c) If $z = 2xy - 3x^y$ and x is increasing at the rate of $2\,\text{cm/s}$, determine at what rate y must be changing in order that z shall be neither increasing nor decreasing at the instant when $x = 3\,\text{cm}$ and $y = 1\,\text{cm}$. Give your answer correct to four decimal places .
Hint: $x^y = e^{y\ln(x)}$.

[4 marks]

(d) Use the series

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \cdots$$

to expand $\ln\left(\dfrac{1-2x}{1+2x}\right)$ as a series of ascending powers of x up to and including the term in x^5 .

[6 marks]

(e) (i) Derive the binomial series for $(1+x^2)^{-1}$ up to the first four non-zero terms .

[2 marks]

(ii) Hence, use the result in (i) to evaluate the integral

$$\int_0^{0.4} \frac{x}{1+x^2}\,dx$$

Let your answer be correct to **four (4)** decimal places .

[4 marks]

Question 4

(a) The rate of change of temperature of a motor is given by

$$\frac{d\theta}{dt} = 10 - k\theta$$

where θ is the temperature of the motor at time t and k is a non-zero constant. Given that $\theta = 0$ when $t = 0$, and $\theta = 60$ when $t = 10$. Show that $e^{-10k} = 1 - 6k$.

[5 marks]

(b) Solve the following differential equations :

(i) $(1+x^2)\dfrac{dy}{dx} + 3xy = 5x$

[6 marks]

(ii) $\dfrac{dy}{dx} + (\tan x)\, y = \sin x$

[5 marks]

(iii) $\dfrac{d^2y}{dx^2} - 3\dfrac{dy}{dx} + 2y = 2x^2$

[9 marks]

Question 5

(a) Use Laplace transfom to solve the following differential equation:

$$\frac{d^2x}{dt^2} - 2\frac{dx}{dt} + 10x = e^{2t}; \quad x(0) = 0, \quad x'(0) = 1.$$

[13 marks]

(b) The marks obtained by 50 students in a particular mathematics examination are normally distributed with mean 55 and standard deviation 12.

(i) Find the probablity that a student obtains a mark between 65 and 75.

[3 marks]

(ii) Given that 67% of the students passed the exam, estimate the minimum mark for passing. Round your answer to the nearest whole number.

[3 marks]

(c) The life span (in hours) for a certain type of battery is shown in the following table:

Class Limits	Frequency
200–299	11
300–399	12
400–499	16
500–599	23
600–699	17
700–799	11
800–899	10

Determine the median and mode of the life span for the 100 batteries.

[6 marks]

End of Paper

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