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FINAL
Examination Paper

(COVER PAGE)

Session	:	April 2014
Programme	:	Diploma in Electrical and Electronic Engineering (DEEI)
Course	:	MAT 1122: Engineering Mathematics 2
Date of Examination	:	22 JULY 2014
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) : **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 2014 SESSION

Instructions

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Question 1

(a) If $z_1 = -2+3i$ and $z_2 = 3-5i$, compute the following and leave your answers in Cartesian form .

(i) $3z_1 - 4z_2$

[2 marks]

(ii) $z_1 z_2$

[3 marks]

(iii) $\dfrac{z_1}{z_1 + z_2}$

[5 marks]

(b) Given $z = -3+4i$.

(i) Express z in polar form, with argument in degrees .

[4 marks]

(ii) Find the two square roots of z. Leave your answers in polar form .

[6 marks]

(c) Use De Moivre's Theorem to express $\left(\frac{1}{2}+\frac{1}{2}i\right)^{10}$ in the form of $a+ib$.

[5 marks]

Question 2

(a) Solve the following by the indicated substitutions :

(i) $\displaystyle\int \frac{\sec^2 x}{\sqrt{1-\tan^2 x}}\,dx\,; \quad u = \tan x$

[4 marks]

(ii) $\displaystyle\int \frac{\ln x}{x}\,dx\,; \quad u = \ln x$

[4 marks]

(iii) $\displaystyle\int \frac{x+1}{\sqrt{x^2+2x+3}}\,dx\,; \quad u = x^2+2x+3$

[4 marks]

(b) Solve the following by any method deemed appropriate :

(i) $\int x \sin^2 x \, dx$ [6 marks]

(ii) $\int \frac{dx}{x^3 + 9x}$ [7 marks]

Question 3

(a) Given $z = e^{x+y} \sin(x^2 y^3)$, find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$. [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) Use Euler's method to solve for the values of y for $x = 0.0(0.1)0.4$ if

$$\frac{dy}{dx} = y^2(1 + 2x), \quad y(0) = 1.$$

Let all workings be correct to **four (4)** decimal places. Formula for Euler's method :

$$\frac{dy}{dx} = f(x, y)$$

$$x_{n+1} = x_n + h$$

$$y_{n+1} = y_n + hf(x_n, y_n)$$

[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 $\ln\left(\frac{1 - 2x}{1 + 2x}\right)$ 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 and including the fourth term.

[2 marks]

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

[6 marks]

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

[5 marks]

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

[9 marks]

Question 5

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

$$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 3y = \sin 2t$$

given that $y(0) = 0$ and $y'(0) = 0$.

[10 marks]

(b) Batteries from a particular manufacturer have a mean lifespan of 160 hours, with standard deviation of 30 hours. Assuming that battery life follows a normal distribution, find the probability of selecting a battery with a lifespan between 150 hours and 180 hours.

[5 marks]

(c) A magician pulls out two rabbits from a sack containing 2 brown rabbits, 5 black rabbits, 3 grey rabbits and 6 white rabbits. Find the probability that

(i) one rabbit is black and one is grey,

[3 marks]

(ii) both are not white.

[2 marks]

(d) The table below shows the daily wages earned by 80 students who worked part time during their semester break :

Weekly wage (RM)	10 – 14	15 – 19	20 – 24	25 – 29	30 – 34	35 – 39	40 – 44
Frequency	4	8	14	22	19	10	3

Estimate the

(i) mean,

[2 marks]

(ii) standard deviation.

[3 marks]

End of Paper

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