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FINAL
Examination Paper

(COVER PAGE)

Session : August 2016

Programme : Diploma in Electrical and Electronic Engineering (DEEI)

Course : **MAT 1122: Engineering Mathematics 2**

Date of Examination : 13 December 2016 (Tuesday)

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) : **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 PROGRAMME (DEE/I)

MAT1122 ENGINEERING MATHEMATICS 2

FINAL EXAM : AUGUST 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. Show complete workings .

Question 1

(a) Find the values of x and y from the following equations :

(i) $i(x+yi) = (1-2i)(1+i)$

[4 marks]

(ii) $\dfrac{i}{x+yi} = \dfrac{2}{3-4i}$

[4 marks]

(b) Solve the equation $z^3 - \sqrt{3} - i = 0$, giving your answer in the form $p[\cos(q^\circ) + i\sin(q^\circ)]$ where p and q are constants.

[5 marks]

(c) Change the number $1+2i$ to polar form. Use the result to find $(1+2i)^4$. Express your answer in the form $x+yi$ where x and y are whole numbers.

[7 marks]

(d) Use Euler's method to find 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. The formula for Euler's method is given below:

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

[5 marks]

Question 2

Evaluate the following integrals:

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

[5 marks]

(b) $\displaystyle\int \tan^{-1} x\,dx,$

[5 marks]

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

[6 marks]

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

[4 marks]

(e) $\displaystyle\int_0^1 xe^{-2x}\,dx,$
with answer in the form $\dfrac{p}{q}\left[1-\dfrac{r}{e^2}\right]$ where p, q, r are constants.

[5 marks]

Question 3

(a) Given that $z = xe^{x^2y}$, find $\dfrac{\partial z}{\partial x}$ and $\dfrac{\partial z}{\partial y}$ and evaluate each at the point $(1, \ln 2)$.

[6 marks]

(b) Use differential dz to approximate the change Δz in the function $z = \sqrt{4-x^2-y^2}$ as (x, y) moves from the point $(1, 1)$ to the point $(1.01, 0.97)$. Compare this approximation with the exact change in z.

[7 marks]

(c) Use the series

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

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

[6 marks]

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

[2 marks]

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

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

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

[4 marks]

Question 4

(a) The voltage V in a circuit that satisfies $V = IR$ is decreasing at the rate of 0.01 volt/sec . At the same time, the resistance R is increasing at the rate of 0.5 ohm/sec. Find the rate of change of the current when $R = 600$ ohm and $I = 0.04$ amp.

[5 marks]

(b) Solve the following separable equation with the given initial condition:

$$(x^2+4)\frac{dy}{dx} = xy, \quad y(0) = 1.$$

[6 marks]

(c) Solve the following first order linear equation:

$$x\frac{dy}{dx} - 2y = x^2.$$

[6 marks]

(d) Verify that the following differential equation

$$(2x + \sin y - ye^{-x})dx + (x\cos y + \cos y + e^{-x})dy = 0$$

is exact and find its solution in the form $\phi(x,y) = C$.

[8 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) A package contains 50 similar components and inspection shows that four have been damaged during transit. If six components are drawn at random from the contents of the package determine the probabilities that in this sample

(i) one component is damaged,

[3 marks]

(ii) less than three components are damaged.

[5 marks]

(c) Replacement times for CD players are normally distributed with a mean of 7.1 years and a standard deviation of 1.4 years.

(i) Find the probability that a randomly selected CD player will have a replacement time less than 8.0 years. [3 marks]

(ii) If you want to provide a warranty so that only 2% of the CD players will be replaced before the warranty expires, what is the time length (to the nearest month) of the warranty? [4 marks]

End of Paper

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