

 **INTI International
University & Colleges**

**FINAL
Examination Paper**

(COVER PAGE)

Session : January/March 2018

Programme : Diploma In Mechanical Engineering (DMEN)

Course : MAT1121 : Engineering Mathematics 1

Date of Examination : March 3, 2018 (Saturday)

Time : 2:00 pm – 4:00 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) : Chong Mee Teng & Dennis Koh Mui Siang

Moderator : Assoc Prof Chan Kait Loon

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

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
MAT1121: ENGINEERING MATHEMATICS 1
FINAL EXAMINATION: JANUARY/MARCH 2018 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) By completing the square, find the stationary point of the function $f(x) = 2x^2 - 10x + 9$. Hence, sketch its graph by indicating the stationary point. (5 marks)

- (b) Simplify the following and write your answers with positive exponents.

(i) $\frac{(xy)^{-2}}{x^{-3}y^2}$ (2 marks)

(ii) $\frac{24^{\frac{1}{4}} \times 108^{\frac{1}{2}}}{36^{\frac{3}{8}}}$ (4 marks)

- (c) Simplify the following and give your answers in surds.

(i) $\sqrt{20} + \sqrt{45}$ (2 marks)

(ii) $\frac{2\sqrt{5}}{\sqrt{3}-\sqrt{2}}$ (3 marks)

- (d) Before a parachute opens, a skydiver's velocity, v (in m/s) is given by $v = 50(1 - e^{-0.2t})$. If the skydiver hits a velocity of 49 m/s, how long ago has he fallen? (4 marks)

- (e) Without using the calculator, simplify the following.

(i) $2\log_{10} 5 + \log_{10} 70 + \log_{10} \frac{45}{35} - \log_{10} \frac{45}{2}$ (3 marks)

(ii) $\log_3 64 \div \log_3 4$ (2 marks)

Question 2

- (a) Solve the following trigonometric equations for $0 \leq x \leq 360^\circ$.
- (i) $\sin x - \sqrt{3} \cos x = 0$ (3 marks)
- (ii) $5 \cos 2x + 8 \sin x = 3$ (5 marks)
- (b) Given that $\frac{3}{2} \lg y = 3 + 3 \lg x$, find the value of x when $y = 9$ without the use of a calculator. (3 marks)
- (c) Given that $\sin A = \frac{3}{5}$ and $\sin B = \frac{5}{13}$, such that A is in first quadrant and B is in second quadrant. Without using a calculator, find the value of $\cos (A-B)$. (6 marks)
- (d) Show that $\frac{2(\sin 45^\circ + \cos 45^\circ)}{\tan 45^\circ + \cot 45^\circ} = \sqrt{2}$. (3 marks)
- (e) Given a triangle with $A = 42^\circ$, $a = 21$, $b = 10$. Solve the triangle. (5 marks)

Question 3

- (a) Find the values of k for which the quadratic equation: $x^2 - 2(1 + 2k)x + 16 + 8k = 0$ has coincident roots. (4 marks)
- (b) The expression $x^3 + 9x^2 + ax + b$ is exactly divisible by $(x + 1)$ and has a remainder of 48 when it is divided by $(x - 1)$. Find the values of a and b . Hence, factorize the expression completely. (7 marks)
- (c) State the amplitude, period and phase shift of $y = -3 \sin(4x - \pi)$. Hence, sketch the curve for one oscillation. (5 marks)
- (d) Change $(-\sqrt{3}, -1)$ from rectangular coordinates to polar coordinates. (3 marks)
- (e) In the expansion of $(4 + \frac{1}{2x})^{12}$, the coefficient of $\frac{1}{x^3}$ is k times the coefficient of $\frac{1}{x^4}$. Calculate the value of k . (6 marks)

Question 4

(a) Find $\frac{dy}{dx}$ for each of the following.

(i) $y = \ln 2x + \sqrt{5x - 2}$ (3 marks)

(ii) $y = \frac{e^x}{e^{x+1}}$ (3 marks)

(iii) $y = \sin^4 x \cos^3 x$ (3 marks)

(b) Find the equation for tangent line of the curve $x^2 + 3xy + 4y^2 = 14$ at point $(5, -1)$. (5 marks)

(c) Find the stationary points of the function $y = 4 + 12x - 3x^2 - 2x^3$ and determine the nature of the stationary points. Hence sketch the graph of the function. (6 marks)

(d) Find the approximate percentage change in the volume of a cube when the length of each side increases by 1.2%. (5 marks)

Question 5

(a) Solve the following integrals.

(i) $\int 3 \sin 2x + 4 \cos \frac{1}{2} x \, dx$ (3 marks)

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

(iii) $\int_1^2 3e^{2x} + 3 \, dx$ (3 marks)

(b) Find an approximate value for $\int_0^1 \sqrt{1+x^3} \, dx$ by the Trapezium rule using intervals, $n = 4$. Show your workings in the form of a table with answers correct to 2 decimal places. (6 marks)

(c) Use Newton's Method to obtain a root of the equation $e^x + x - 3 = 0$ with the initial value, $x_0 = 1$. Give your answer correct to three decimal places. (5 marks)

(d) Find the area bounded by $f(x) = x^2 - 3x + 7$ and $g(x) = 2x + 7$. Round the answer to two decimal places. (5 marks)

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