



FINAL  
Examination Paper

(COVER PAGE)

Session : August 2017

Programme : Diploma In Mechanical Engineering (DMEN)

Course : MAT1121: Engineering Mathematics 1

Date of Examination : December 9, 2017 (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) questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Non-Programmable Calculator

Materials provided :

**Formula Booklet 1 & Polar Graph Paper (last page of the question paper must be attached together with the answer booklet)**

Examiner(s) : Teow Hsien Loong, Chong Mee Teng

Moderator : Assoc. Prof. Chan Kait Loon

*This paper consists of 5 printed pages, including the cover page.*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)  
MAT1121: ENGINEERING MATHEMATICS 1  
FINAL EXAMINATION : AUGUST 2017 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) Solve the following equations:

(i)  $3^{2x+1} - 26(3^x) - 9 = 0$ . (5 marks)

(ii)  $\sqrt{4x-9} + 1 = 2\sqrt{x}$ . (4 marks)

(b) Express  $\frac{2\sqrt{7}}{\sqrt{7}+2}$  as a single fraction with rational denominator. (3 marks)

(c) The cubic polynomial  $f(x) = 3x^3 + 2x^2 - bx + a$  is divisible by  $(x-1)$  but leaves a remainder of 10 when divided by  $(x+1)$ . Calculate the values of  $a$  and  $b$  and hence, solve the polynomial. (6 marks)

(d) Find the range of values of  $p$  for which the equation:  $(x+1)^2 + p - 16 = 0$  has real roots. (3 marks)

(e) Express  $y = 3x^2 - 4x + 5$  in the form  $y = 3(x-p)^2 + q$  where  $p$  and  $q$  are constants. Find  $p$  and  $q$ . Hence sketch the graph of  $y = 3x^2 - 4x + 5$ . (4 marks)

**Question 2**

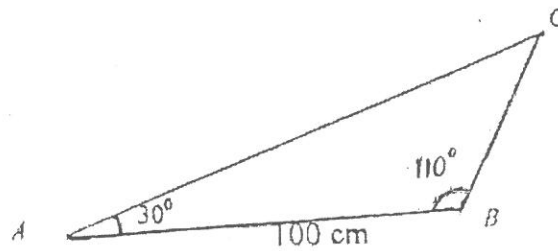
- (a) Find  $x$  for the trigonometry equation:  $2 \tan^2 x + 5 \tan x - 3 = 0$  for  $0^\circ \leq x \leq 360^\circ$ . (7 marks)
- (b) Prove the identity:  $\cos^2 x (\operatorname{cosec}^2 x - \cot^2 x) \equiv \cos^2 x$ . (5 marks)
- (c) State the amplitude, period and phase shift of  $y = 3 \sin\left(\frac{1}{2}x + \pi\right)$ . Hence, sketch the curve for one oscillation. (5 marks)
- (d) Change  $(-\sqrt{3}, -1)$  from rectangular coordinates to polar coordinates. (3 marks)
- (e) Sketch the graph:  $r = 5 \cos \theta$ ,  $0^\circ \leq \theta \leq 360^\circ$  on the polar axis. (5 marks)

**[Please detach the polar graph paper provided from the question paper and tie it together with your answer booklet]**

**Question 3**

- (a) Solve the equation:  $2 \cosh^2 x - \sinh x = 3$ . (6 marks)
- (b) Find the center and radius of circle:  $(x - 3)^2 + (y + 4)^2 = 36$ . Then graph the circle. (5 marks)
- (c) Expand and simplify the first five terms of  $(x^2 - 2)^9$  by using the binomial theorem. (3 marks)
- (d) Find the term independent of  $x$  in the expansion of  $\left(2x^3 - \frac{1}{x}\right)^{12}$ . (5 marks)

- (e) In triangle  $ABC$ ,  $\angle ABC = 110^\circ$ ,  $\angle CAB = 30^\circ$  and  $AB = 100$  cm, as shown in the **Figure (1)**.



**Figure (1)**

- (i) Calculate the distance from  $B$  to  $C$ . (3 marks)
- (ii) Calculate the area of the triangle  $ABC$ . (3 marks)

#### Question 4

- (a) Find  $\frac{dy}{dx}$  and simplify the answers for each of the following:
- (i)  $y = x^3 \cos 2x$ . (3 marks)
- (ii)  $y = \frac{e^{2x}}{x - 3e}$ . (3 marks)
- (iii)  $y = \ln\left(\frac{x-1}{2-x}\right)^2$ . (3 marks)
- (b) Find the equation of the line that is tangent to the curve  $4x^2 + 2xy^3 - 5y^2 = 0$  at the point  $(1, 2)$ . (5 marks)
- (c) Find the stationary points of the function  $y = x^3 - 3x + 5$  and determine the nature of the stationary points. Hence, sketch the graph of the function. (6 marks)
- (d) The radius of a circle increases at rate of  $0.6 \text{ cm s}^{-1}$ . Calculate the rate of the increase of the area when the radius is 10 cm. (5 marks)

**Question 5**

- (a) Find the following integrals:
- (i)  $\int \frac{2}{(2x-3)^3} dx$ . (3 marks)
- (ii)  $\int \cos 4x \cos x dx$ . (3 marks)
- (iii)  $\int_1^2 3e^{2x} + 3 dx$ . (3 marks)
- (b) Use Simpson's rule with 6 equal intervals to find an approximate value for  $\int_1^{16} \log(1+x^3) dx$ . Show your working in the form of a table and give your final answer to 3 significant figures. (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 enclosed by the curves  $y = 4x^2$  and  $y^2 = 2x$ . (5 marks)

**- THE END -**

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