CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LED12502**
SUBJECT TITLE	:	**TECHNICAL MATHEMATICS 2**
PROGRAMME NAME **(FOR MPU: PROGRAMME LEVEL)**	:	**DIPLOMA OF ENGINEERING TECHNOLOGY IN ELECTRICAL AND ELECTRONICS (MARINE)**
TIME / DURATION	:	**2.00 PM - 4.30 PM** **(2 HOURS 30 MINUTES)**
DATE	:	**28 JUNE 2025**

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of **TWO (2)** sections; Section A and Section B.
4. Answer **ALL** question in Section A, and **TWO (2)** questions ONLY in Section B.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Answer should be written in blue or black ink except for sketching, graphic and illustration.
8. Formula is appended for your reference.

THERE ARE 7 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A: 60 marks

INSTRUCTION: Answer ALL questions.

Question 1

With reference to Trigonometry and Geometry;

(a) Define and sketch in one diagram the following geometric terms:

i. Radius (2 marks)

ii. Diameter (2 marks)

iii. Chord (2 marks)

iv. Tangent (2 marks)

v. Sector (2 marks)

(b) Describe the meaning of the terms angle of elevation and angle of depression in trigonometry and illustrate each with a simple labelled diagram. (6 marks)

(c) Based on Figure 1 below, identify the equation of the function y and state the corresponding values of its amplitude and period.

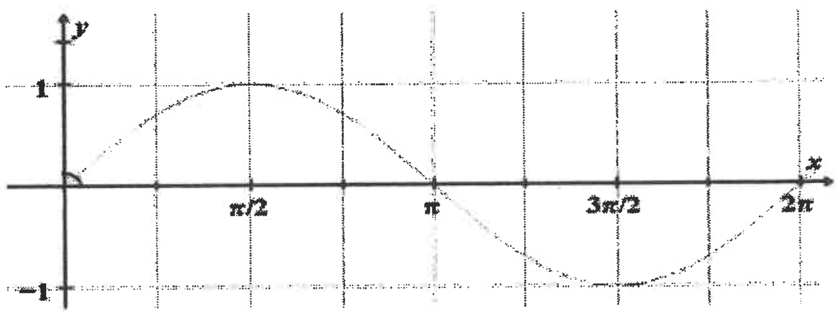

Figure 1

(4 marks)

Question 2

With reference to Geometry;

(a) Find the area of the shaded region in Figure 2 below. The hexagon in the middle of the figure has sides measuring 3 cm each.

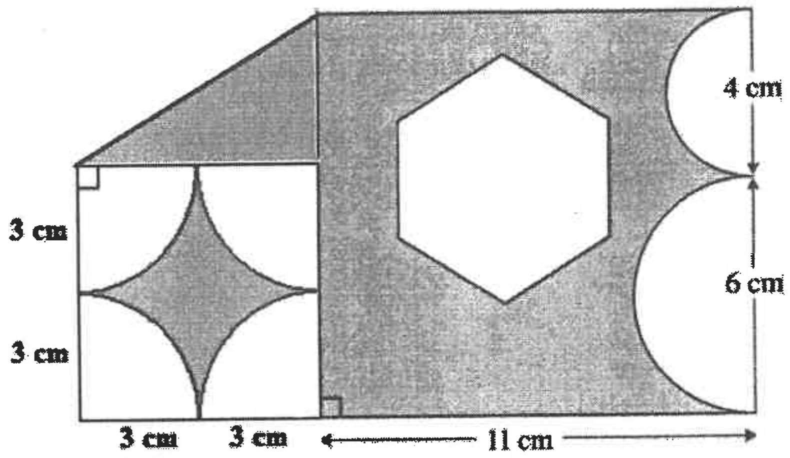

Figure 2

(14 marks)

(b) Figure 3 below shows a sector centre O. Determine the arc of length and area of the sector.

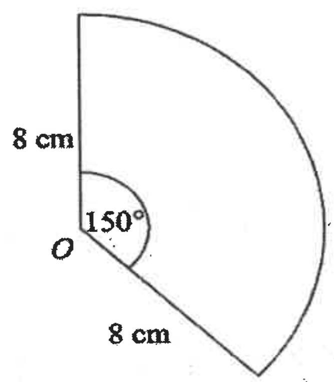

Figure 3

(6 marks)

Question 3 (CLO2)

With reference to Geometry;

(a) Figure 4 below shows a sector of circle. Find:

i. the perimeter of the sector *BAC* if *BA* = *AC*.

(4 marks)

ii. the area of the shaded region.

(6 marks)

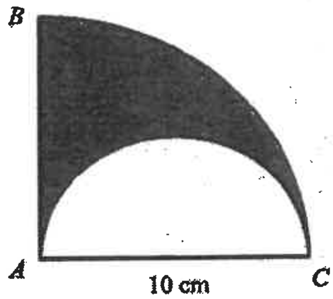

Figure 4

(b) Calculate the surface area of the following Figure 5.

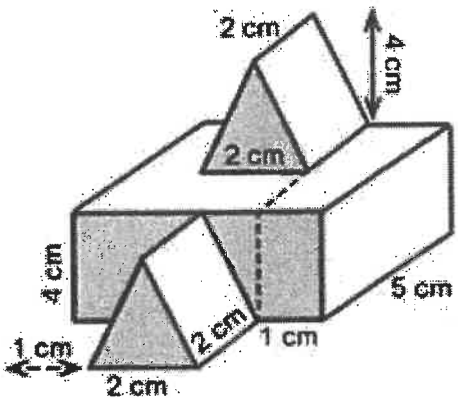

Figure 5

(10 marks)

SECTION B: 60 marks

INSTRUCTION: Answer TWO (2) QUESTIONS only

Question 4

With reference to Differentiation;

(a) In an electrical transmission system, the position of a moving current y is related to the horizontal voltage x along a conductor in the circuit. The relationship between the voltage and current is described by the equation $x^2 + y^2 = 7$.

i. Determine $\frac{dy}{dx}$ by using implicit differentiation.

(8 marks)

ii. From question 4 (a) i. above, find the rate of change of voltage $\frac{dy}{dx}$ if given current $y = 1$ when voltage $x = 1$.

(2 marks)

(b) A spherical capacitor is being charged and the radius of the spherical conductor is increasing due to thermal expansion. The volume of the spherical capacitor is increasing at a rate of $\frac{dV}{dt} = \frac{10cm^3}{sec}$. Find the rate at which the radius, $\frac{dr}{dt}$ and the surface area, $\frac{dA}{dt}$ of the spherical capacitor is increasing when the radius is $r = 4\ cm$.

(10 marks)

Question 5

With reference to Integration;

(a) An electrical filter circuit whose transfer function is given by the following equation *where* *H(x)* is the transfer function of the filter and x represents the input frequency variable.

$$H(x) = \frac{7x^2-6x+2}{(x+1)(x-4)} = \frac{A}{x+1} + \frac{B}{x-4}$$

i. Find the values of A and B.

(8 marks)

ii. Hence, solve $\int \frac{7x^2-6x+2}{(x+1)(x-4)}$ dx.

(2 marks)

(b) Suppose the cross-sectional shape of the ship's hull is approximated by two curves with the following equations. Integrate these equations to determine the area enclosed by the curves and give the answer correct to two decimal places.

i. $\int_1^2 (2x^4 + x^3 + 4x^2)\, dx.$

(6 marks)

ii. $\int_0^{\pi} (\cos(x) + 6\sin(3x)\, dx.$

(4 marks)

Question 6

With reference Differentiation and Integration;

(a) Find $\frac{dY}{dx}$ of displacement and power systems with respect to time, x.

i. $Y1 = (3x^3 - 6x^0 + 9)^4$.

(3 marks)

ii. $Y2 = (x^3 - 4x^2)(2x^{-4} - x^9)$.

(5 marks)

(b) The partition area along the ship's hull is modelled by the curve $P(x) = 2x^2 + 3x$, where x represents the horizontal distance along the length of the hull. Compute the area using the integration below with given 8 intervals. Use Simpson's rule, each answer correct to 3 decimal places.

$$\int_1^4 P(x)\,dx$$

(12 marks)

END OF EXAMINATION PAPER

FORMULA SHEET

DIFFERENTIATION

STANDARD FORM	GENERAL FORM
$\frac{d}{dx}(\sin x)=\cos x$	$\frac{d}{dx}(\sin f(x))=f'(x)\cos f(x)$
$\frac{d}{dx}(\cos x)=-\sin x$	$\frac{d}{dx}(\cos f(x))=-f'(x)\sin f(x)$
$\frac{d}{dx}(\tan x)=\sec^2 x$	$\frac{d}{dx}(\tan f(x))=f'(x)\sec^2 f(x)$
$\frac{d}{dx}(\csc x)=-\csc x\cot x$	$\frac{d}{dx}(\csc f(x))=-f'(x)\csc f(x)\cot f(x)$
$\frac{d}{dx}(\sec x)=\sec x\tan x$	$\frac{d}{dx}(\sec f(x))=f'(x)\sec f(x)\tan f(x)$
$\frac{d}{dx}(\cot x)=-\csc^2 x$	$\frac{d}{dx}(\cot f(x))=-f'(x)\csc^2 f(x)$

EXPONENTIAL FUNCTION

STANDARD FORM	GENERAL FORM
$\frac{d}{dx}e^x=e^x$	$\frac{d}{dx}e^{f(x)}=f'(x)e^{f(x)}$

LOGARITHMIC FUNCTION

STANDARD FORM	GENERAL FORM
$\frac{d}{dx}\ln x=\frac{1}{x}$	$\frac{d}{dx}\ln f(x)=\frac{f'(x)}{f(x)}$

INTEGRATION

STANDARD FORM	GENERAL FORM Where : $f(x) = ax + b$
$\int \cos x\,dx = \sin x + c$	$\int \cos f(x)dx = \dfrac{\sin f(x)}{f'(x)} + c$
$\int \sin x\,dx = -\cos x + c$	$\int \sin f(x)dx = \dfrac{-\cos f(x)}{f'(x)} + c$
$\int \sec^2 x\,dx = \tan x + c$	$\int \sec^2 f(x)dx = \dfrac{\tan f(x)}{f'(x)} + c$
$\int \sec x \tan x\,dx = \sec x + c$	$\int \sec f(x) \tan f(x)dx = \dfrac{\sec f(x)}{f'(x)} + c$
$\int \csc x \cot x\,dx = -\csc x + c$	$\int \csc f(x) \cot f(x)dx = \dfrac{-\csc f(x)}{f'(x)} + c$
$\int \csc^2 x\,dx = -\cot x + c$	$\int \csc^2 f(x)dx = \dfrac{-\cot f(x)}{f'(x)} + c$
$\int \tan x\,dx = \ln\lvert\sec x\rvert + c$	$\int \tan x\,dx = \dfrac{\ln\lvert\sec f(x)\rvert}{f'(x)} + c$
$\int \sec x\,dx = \ln\lvert\sec x + \tan x\rvert + c$	$\int \sec x\ dx = \dfrac{\ln\lvert\sec f(x) + \tan f(x)\rvert}{f'(x)} + c$
$\int \cot x\,dx = \ln\lvert\sin x\rvert + c$	$\int \cot x\,dx = \dfrac{\ln\lvert\sin f(x)\rvert}{f'(x)} + c$
$\int \csc x\,dx = -\ln\lvert\csc x + \cot x\rvert + c$	$\int \csc x dx = \dfrac{-\ln\lvert\csc f(x) + \cot f(x)\rvert}{f'(x)} + c$

EXPONENTIAL FUNCTION

STANDARD FORM	GENERAL FORM Where : $f(x) = ax + b$
$\int e^x dx = e^x + c$	$\int e^{f(x)}\,dx = \dfrac{e^{f(x)}}{f'(x)} + c$

LOGARITHMIC FUNCTION

STANDARD FORM	GENERAL FORM Where : $f(x) = ax + b$
$\int \dfrac{1}{x} dx = \ln\lvert x\rvert + c$	$\int \dfrac{1}{f(x)} dx = \dfrac{\ln\lvert f(x)\rvert}{f'(x)} + c$

APPROXIMATE INTEGRATION

TRAPEZOIDAL RULE: $\text{Area} = \frac{h}{2}[y_0 + y_n + 2(y_1 + y_2 + ... + y_{n-1})]$
SIMPSON'S RULE: $\text{Area} = \frac{h}{3}[y_0 + 4y_1 + 2y_2 + 4y_3 + 2y_4 + ... + y_n]$
MID ORDINATE RULE : $\text{Area} = h\sum y_n$

GEOMETRY AND MENSURATION

AREA	GENERAL FORM
TRAPEZIUM	$A = \frac{1}{2}(b_2 + b_1)h$
TRIANGLE	$A = \frac{1}{2}\, b\, h$
CIRCLE	$A = \pi r^2$
PARALLEOGRAM	$A = b\, h$

VOLUME	GENERAL FORM
CYLINDER	$V = \pi r^2 h$
PRISM	$V = A\, h$
SPHERE	$V = \frac{4}{3}\pi r^3$
CONE	$V = \frac{1}{3}\pi r^2 h$