UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
MARCH 2025 SEMESTER SESSION

SUBJECT CODE	:	**LGB13603**
SUBJECT TITLE	:	**ENGINEERING MATHEMATICS 2**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**BET (OFFSHORE) WITH HONOURS**
TIME / DURATION	:	**09.00 AM - 12.00 PM** **(3 HOURS)**
DATE	:	**24 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 FIVE (5) questions.

4. Answer ALL questions in the answer booklet provided.

5. Answer all questions in English language ONLY.

6. Answer should be written in blue or black ink except for sketching, graphic and illustration.

7. Formula sheet has been appended for your reference.

THERE ARE 4 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

(Total: 100 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

With reference to Calculations with Statistic;

(a)

Table 1: Extra time (Hours)

Class	f (Frequency)
30 – 33	5
34 – 37	7
38 – 41	4
42 – 45	4
46 – 49	6
50 – 53	8
54 – 57	4

A group of marine engineers at Company Marine Aqua Sdn Bhd recorded the extra hours worked over a period of one month. Table 1 shows the extra time worked by each engineer (in hours). Using the given data, find:

i. Mean.   (4 marks)

ii. Mean Deviation.   (5 marks)

iii. Median.   (4 marks)

iv. Variance.   (5 marks)

v. Standard deviation.   (2 marks)

Question 2

With reference to Calculations with Differentiate and its Application.

(a) If given $y = 5x^3 - 4x^2 + 3x - 1$, find $\dfrac{dy}{dx}$. (3 marks)

(b) Find y' for each of the following using method of differentiation

    i. $y = (3x - 2)(x^2 + 1)$, by using product rule. (4 marks)

    ii. $y = (x^2 + 2)^2$, by using chain rule. (4 marks)

    iii. $y = \dfrac{2x}{(2x+5)^3}$, by using quotient rule. (5 marks)

(c) A spherical balloon is being inflated with gas in such a way that the radius is (4 marks)
increasing at a rate of 2 cm per second. When the radius reaches 5 cm, determine
how fast the volume, $(v = \dfrac{4}{3}\pi r^3)$ of the balloon is changing at that moment?

Question 3

With reference to Calculations with Integration and Application

(a) Evaluate the following integration

I. $\int \left(-3p-18x\right)^{-5} dx$ (3 marks)

II. $\int 2x\left(2+x^2\right)^6 dx$ (4 marks)
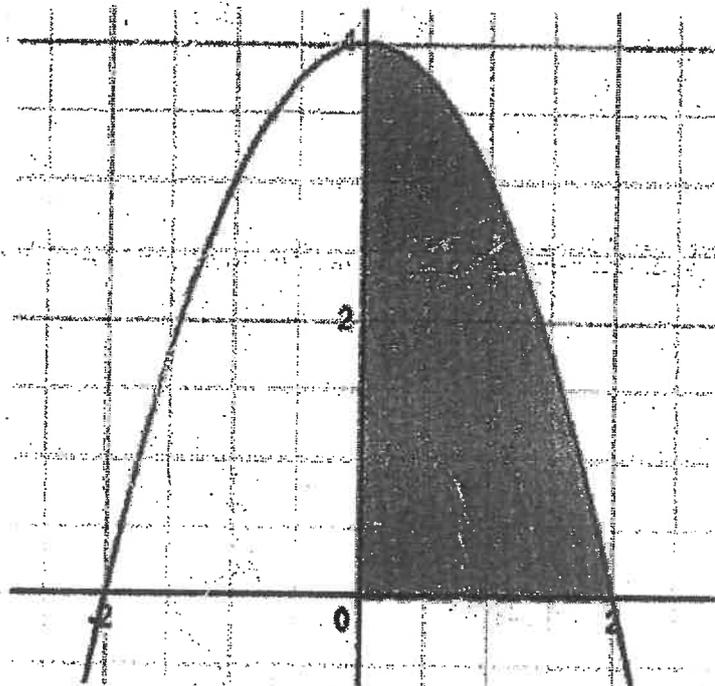
(b) Solve $\int \dfrac{2-x}{x(x+5)} dx$ by using partial fraction method.   (8 marks)

(c) Determine the area of the shaded region based on Figure 1 with given   (5 marks)
      $y = 4 - x^2$ and the $x = 2$

Figure 1

Question 4

With reference to Calculations with Differential Equations.

Solve the following differential equation.

(a)　$\dfrac{dy}{dx} = 2e^{4x} + \dfrac{1}{x^2}$, by using direct integration method.　(5 marks)

Solve the following differential equations by using separable differential equation method.

(b)　i. $dy = 2(25 - y)dt$.　(5 marks)

ii. $\dfrac{dy}{dx} = y^2 e^{3x}$.　(5 marks)

iii. $\dfrac{dy}{dx} = \dfrac{2x}{y+1}$.　(5 marks)

Question 5

With reference to Calculations with Laplace Transform.

(a)　Transfer the following transition into Laplace Transform by using definition method

i. $f(t) = a$　(3 marks)

ii. $f(t) = e^{at}$　(3 marks)

iii. $f(t) = 2t^4$　(4 marks)

(b)　Solve the following problems using the Laplace Transform table

i. $f(t) = 3e^{2t} + 4\sin 5t$.　(5 marks)

ii. $f(t) = \cos 4t + \sin 7t$.　(5 marks)

END OF EXAMINATION PAPER

ENGINEERING MATHEMATICS 2

STATISTICS

Means:

$$\bar{x} = \frac{\sum_i f_i x_i}{\sum_i f_i}$$

Modes:

$$= L + \left[\frac{a}{a+b}\right]c$$

Median:

$$= L + \left[\frac{\frac{N}{2} - f_L}{f_m}\right]c$$

E = Mean Deviation

$$E = \frac{\sum |x - \bar{x}| f}{\sum f}$$

Ungroup data:

Variance:

$$s^2 = \frac{\sum_i (x_i - \bar{x})^2}{n-1} \quad \text{or} \quad s^2 = \frac{\sum_i x_i^2 - \frac{\left(\sum_i x_i\right)^2}{n}}{n-1}$$

Standard deviation

$$s = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{n-1}}$$

Grouped data:

Variance:

$$s^2 = \frac{\left(\sum_{i=1}^n x_i^2 f\right) - \frac{\left(\sum_{i=1}^n x_i f\right)^2}{n}}{n-1}$$

Standard Deviation:

$$s = \sqrt{\frac{\left(\sum_{i=1}^n x_i^2 f\right) - \frac{\left(\sum_{i=1}^n x_i f\right)^2}{n}}{n-1}}$$

TRIGONOMETRY IDENTITIES

FUNDAMENTAL IDENTITIES	FORMULAS FOR NEGATIVES
$\csc\theta = \dfrac{1}{\sin\theta}$	$\sin(-\theta) = -\sin\theta$
$\sec\theta = \dfrac{1}{\cos\theta}$	$\cos(-\theta) = \cos\theta$
$\cot\theta = \dfrac{1}{\tan\theta} = \dfrac{\cos\theta}{\sin\theta}$	$\tan(-\theta) = -\tan\theta$
$\cos^2\theta = \dfrac{1}{2}(1+\cos2\theta)$	$\csc(-\theta) = -\csc\theta$
$\sin^2\theta + \cos^2\theta = 1$	$\sec(-\theta) = \sec\theta$
$1 + \tan^2\theta = \sec^2\theta$	$\cot(-\theta) = -\cot\theta$
$1 + \cot^2\theta = \csc^2\theta$	$\sin^2\theta = \dfrac{1}{2}(1-\cos2\theta)$

ADDITION FORMULAS	SUBTRACTION FORMULAS
$\sin(A+B) = \sin A\cos B + \cos A\sin B$	$\sin(A-B) = \sin A\cos B - \cos A\sin B$
$\cos(A+B) = \cos A\cos B - \sin A\sin B$	$\cos(A-B) = \cos A\cos B + \sin A\sin B$
$\tan(A+B) = \dfrac{\tan A + \tan B}{1 - \tan A\tan B}$	$\tan(A-B) = \dfrac{\tan A - \tan B}{1 + \tan A\tan B}$

HALF-ANGLE FORMULAS	DOUBLE-ANGLE FORMULAS
$\sin\dfrac{\theta}{2} = \pm\sqrt{\dfrac{1-\cos\theta}{2}}$	$\sin2\theta = 2\sin\theta\cos\theta$
$\cos\dfrac{\theta}{2} = \pm\sqrt{\dfrac{1+\cos\theta}{2}}$	$\cos2\theta = \cos^2\theta - \sin^2\theta$ $\dots\dots = 1 - 2\sin^2\theta$ $\dots\dots = 2\cos^2\theta - 1$
$\tan\dfrac{\theta}{2} = \dfrac{1-\cos\theta}{\sin\theta} = \dfrac{\sin\theta}{1+\cos\theta}$	$\tan2\theta = \dfrac{2\tan\theta}{1-\tan^2\theta}$

PRODUCT-TO-SUM FORMULAS	SUM-TO-PRODUCT FORMULAS
$\sin\alpha\cos\beta = \dfrac{1}{2}[\sin(\alpha+\beta) + \sin(\alpha-\beta)]$	$\sin\alpha + \sin\beta = 2\sin\dfrac{\alpha+\beta}{2}\cos\dfrac{\alpha-\beta}{2}$
$\cos\alpha\sin\beta = \dfrac{1}{2}[\sin(\alpha+\beta) - \sin(\alpha-\beta)]$	$\sin\alpha - \sin\beta = 2\cos\dfrac{\alpha+\beta}{2}\sin\dfrac{\alpha-\beta}{2}$
$\cos\alpha\cos\beta = \dfrac{1}{2}[\cos(\alpha+\beta) + \cos(\alpha-\beta)]$	$\cos\alpha + \cos\beta = 2\cos\dfrac{\alpha+\beta}{2}\cos\dfrac{\alpha-\beta}{2}$

DIFFERENTIATION

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

EXPONENTIAL FUNCTION

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

LOGARITHMIC FUNCTION

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

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

Formulation of Direct Integration

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

$$\int dy = \int f(x) dx$$

$$y = \int f(x) dx$$

Formulation of 1ˢᵗ Ode Sova

$$\frac{dy}{dx} = g(x)h(y)$$

$$\int h(y) dy = \int g(x) dx$$

Formulation of 1ˢᵗ Ode Homogenous

$$\frac{dy}{dx} = v + x\frac{dv}{dx}$$

Formulation of 2ⁿᵈ Ode Homogenous Constant Coefficient

Case 1: Distinct and Real Roots

$$m_1 \neq m_2$$

The general solution is $\quad y = c_1 e^{m_1 x} + c_2 e^{m_2 x}$

Case 2: Repeated Real Roots

$$m_1 = m_2$$

The general solution is $\quad y = c_1 e^{m_1 x} + c_2 x e^{m_1 x}$

Case 3: Conjugate Complex Roots

$$y = e^{\alpha x}(c_1 \cos \beta x + c_2 \sin \beta x)$$

The general solution is $\quad m_1 = \alpha + i\beta \ , \ m_2 = \alpha - i\beta$

ENGINEERING MATHEMATICS 2
Table Laplace Transform

No.	$f(t)$	$F(s)$	No.	$f(t)$	$F(s)$
1.	a	$\dfrac{a}{s}$	12.	$e^{-at}\sin\omega t$	$\dfrac{\omega}{(s+a)^2+\omega^2}$
2.	t^n	$\dfrac{n!}{s^{n+1}}$	13.	$e^{-at}\cos\omega t$	$\dfrac{s+a}{(s+a)^2+\omega^2}$
3.	$\dfrac{t^{n-1}}{(n-1)!}$	$\dfrac{1}{s^n}$	14.	$\sinh\omega t$	$\dfrac{\omega}{s^2-\omega^2}$
4.	e^{-at}	$\dfrac{1}{s+a}$	15.	$\cosh\omega t$	$\dfrac{s}{s^2-\omega^2}$
5.	te^{-at}	$\dfrac{1}{(s+a)^2}$	16.	$e^{-at}\sinh\omega t$	$\dfrac{\omega}{(s+a)^2-\omega^2}$
6.	$t^n e^{at}$	$\dfrac{n!}{(s-a)^{n+1}}$	17.	$e^{-at}\cosh\omega t$	$\dfrac{s+a}{(s+a)^2-\omega^2}$
7.	$t^n \cdot f(t)$	$(-1)^n \dfrac{d^n}{ds^n}[F(s)]$	18.	$f_1(t)+f_2(t)$	$F_1(s)+F_2(s)$
8.	$\sin\omega t$	$\dfrac{\omega}{s^2+\omega^2}$	19.	$\int_0^t f(u)\,du$	$\dfrac{F(s)}{s}$
9.	$\cos\omega t$	$\dfrac{s}{s^2+\omega^2}$	20.	$f(t-a)u(t-a)$	$e^{-as}F(s)$
10.	$t\sin\omega t$	$\dfrac{2\omega s}{(s^2+\omega^2)^2}$	21.	First derivative $\dfrac{dy}{dt},\,y'(t)$	$sY(s)-y(0)$
11.	$t\cos\omega t$	$\dfrac{s^2-\omega^2}{(s^2+\omega^2)^2}$	22.	Second derivative $\dfrac{d^2 y}{dt^2},\,y''(t)$	$s^2Y(s)-sy(0)-y'(0)$