CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
OCTOBER 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	:	**29 JANUARY 2026**

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 5 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) Define the meaning of statistics.
(2 marks)

(b) There are two types of variables: quantitative and qualitative. Give one example of each type.
(2 marks)

(c) To study extreme weather patterns, a climate agency analyzed historical high-temperature records across the United States. The table below represents the record of high temperatures in Fahrenheit for each of the 50 states.

Table 1: Temperature (Farenheit)

Temperature	f (Frequency)
100 - 104	2
105 - 109	8
110 - 114	18
115 - 119	13
120 - 124	7
125 - 129	1
130 - 134	1

Using the given data, answer the following questions:

i. Construct a cumulative frequency distribution table.
(2 marks)

ii. Calculate the mean, median, and mode for the data.
(8 marks)

iii. Draw an ogive using the given data using the graph paper.
(6 marks)

Question 2

With reference to Calculations with Differentiate and its Application:

(a) Differentiate the given function to obtain the $\frac{dy}{dx}$.

$$7 + x^2 + 3x^3$$

(2 marks)

(b) Differentiate each of the following function using the differentiation method:

i. $y = (2x + 7)(x^2 - 6x + 1)$

(3 marks)

ii. $y = e^{-4x}$

(3 marks)

iii. $y = x^3 \sin x$

(3 marks)

iv. $y = \frac{x^2+1}{x^3+5}$

(4 marks)

(c) The radius r of a circle increases from 10m to 10.1m. Estimate the increase in the circle's area A by calculating dA.

(5 marks)

Question 3

With reference to Calculations with Integration and Application:

(a) Integrate the following function with respect to x.

i. $\int (5x + 4\sin x - 4)\, dx$

(3 marks)

ii. $\int (4 - e^{-x})\, \mathrm{dx}$

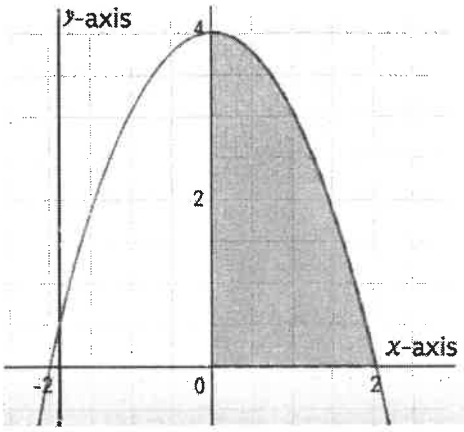
(3 marks)

(b) Solve the following by using partial fraction method.

$$\int \frac{3x^2 + 5x + 2}{(x-1)(x+1)(x+2)} dx$$

(8 marks)

(c) Determine the area between $y = 4 - x^2$ and the x-axis from $x = 0$ to $x = 2$



(6 marks)

Question 4

With reference to Calculations with Differential Equations:

(a) Obtain the general solution for the separable equation below.

$$\frac{dy}{dx} = 4e^{x}y^{2}$$

(4 marks)

(b) Solve the following second order differential equation.

$$\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 10$$

(6 marks)

(c) Given the initial value problem as below, determine the particular solution of the differential equation.

$$\frac{dy}{dx} + 2y = x + 1, y(0) = 2$$

(10 marks)

Question 5

With reference to Calculations with Laplace Transform:

(a) Solve the following function by using Laplace Transform table:

i. $f(t) = te^{3t}$

(2.marks)

ii. $f(t) = 5\,cos\,(t)$

(2 marks)

iii. $f(t) =- 6$

(2 marks)

iv. $\mathrm{f(t) = 5t^2 + 3t - 4 + te^t}$

(4 marks)

v. $\mathrm{f(t) = 2e^{5t} - 7\sin(2t) + t^2e^{3t}}$

(4 marks)

(b) Evaluate the inverse Laplace transform of $Y(s)$ and hence determine the solution $y(t)$. Consider the differential equation as below:

$$\mathrm{y' + y = e^{-t},\ y(0) = 0}$$

(6 marks)

TRIGONOMETRY IDENTITIES

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

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
$\sin\dfrac{\theta}{2} = \pm\sqrt{\dfrac{1-\cos\theta}{2}}$	$\sin 2\theta = 2\sin\theta\cos\theta$
$\cos\dfrac{\theta}{2} = \pm\sqrt{\dfrac{1+\cos\theta}{2}}$	$\cos 2\theta = \cos^2\theta - \sin^2\theta$ $\ldots\ldots\ldots = 1-2\sin^2\theta$ $\ldots\ldots\ldots = 2\cos^2\theta - 1$
$\tan\dfrac{\theta}{2} = \dfrac{1-\cos\theta}{\sin\theta} = \dfrac{\sin\theta}{1+\cos\theta}$	$\tan 2\theta = \dfrac{2\tan\theta}{1-\tan^2\theta}$

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

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:

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

INTEGRATION

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

EXPONENTIAL FUNCTION

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

LOGARITHMIC FUNCTION

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

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

ENGINEERING MATHEMATICS 2

Table Laplace Transform

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

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 $y = c_1e^{m_1x} + c_2e^{m_2x}$

Case 2: Repeated Real Roots

$$m_1 = m_2$$

The general solution is $y = c_1e^{m_1x} + c_2xe^{m_1x}$

Case 3: Conjugate Complex Roots

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

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