UNIVERSITI KUALA LUMPUR

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MALAYSIAN ITALY DESIGN INSTITUTE

FINAL EXAMINATION
MARCH 2026 SEMESTER

COURSE CODE	: PPB 10103
COURSE NAME	: ENGINEERING MATHEMATICS 1
PROGRAMME NAME	: DEGREE
DATE	: 26 JUNE 2026
TIME	: 9.00 AM – 11.30 AM
DURATION	: 2 HOURS 30 mins

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read 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 questions in Section A and Section B.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English language ONLY.
7. Formula sheet has been appended for your reference.

THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

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

Question 1

(a) Given the position vectors

$$\overrightarrow{OA} = 2\mathrm{i} + \mathrm{j} - \mathrm{k}, \qquad \overrightarrow{OB} = 4\mathrm{i} - \mathrm{j} + 2\mathrm{k},$$

Find the vector $\overrightarrow{AB}$. Hence, find the unit vector in the direction of $\overrightarrow{AB}$.

(4 marks)

(b) Given the vectors

$$\mathrm{a} = \mathrm{i} + 2\mathrm{j} + 2\mathrm{k}, \mathrm{b} = 2\mathrm{i} + \mathrm{j} + 2\mathrm{k},$$

Find the angle between vectors a and b. Determine whether the vectors are orthogonal.

(6 marks)

Question 2

(a) Given that $z_1 = 10 + 28i$ and $z_2 = 13 + 30i$, find

(i) $\frac{1}{2} z_1 z_2$

(ii) $\frac{3}{2} \frac{z_1}{z_2}$

Express in the form of $a + bi$.

(6 marks)

(b) Express $z = 4 + \sqrt{5}i$ in polar form and evaluate z^2 in terms of $a + bi$.

(4 marks)

Question 3

Given the following functions, find the first derivative with respect to x:

(a) $f(x) = 3x^4 - 5x^2 + 2x - 1$

(2 marks)

(b) $f(x) = (2x+1)^3$

(3 marks)

(c) $f(x) = (x^2+1)(x-3)$

(3 marks)

(d) $f(x) = \dfrac{x^2+2x}{x-1}$

(2 marks)

Question 4

Integrate each of the following functions:

a) $\int 2x^3 - 3e^{-x}\,dx$

(2 marks)

b) $\int \dfrac{3x^2-6}{x^3-6x+8}\,dx$; by substitution,

(2 marks)

c) $\int x \sin x\,dx$; by parts,

(3 marks)

d) $\int \dfrac{2x+3}{(x+1)(x+2)}\,dx$; by partial fractions.

(3 marks)

Question 5

(a) Find the solution of the differential equation using the separable variable method.

$$\frac{dy}{dx} = \frac{x+5}{y}, \quad y(2) = -1$$

(5 marks)

(b) Find the integrating factor and hence solve the equation:

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

(5 marks)

QUESTION 6

Given

$$A = \begin{bmatrix} 2 & -1 \\ 3 & 4 \end{bmatrix}, \; B = \begin{bmatrix} 1 & 2 \\ 0 & -3 \end{bmatrix}$$

(a) Find $A+B$ and $A-B$.

(2 marks)

(b) Find the product AB.

(2 marks)

(c) Find the determinant of matrix A.

(3 marks)

(d) Find the inverse of matrix A.

(3 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

(a) The region R is bounded by the curve, $y = \sqrt{4-x}$ when the x-axis between $x = 0$ and $x = 4$.

i. Find the area of the region R.

(5 marks)

ii. Find the volume of the solid formed when the region R is revolved about the x-axis.

(5 marks)

(b) i. Given $y = 3x^4 - 2x^3 + x^2 - x$, find $\frac{d^3y}{dx^3}$.

(5 marks)

ii. Differentiate: $y = e^{\sin(x^2+1)}$

(5 marks)

Question 2

(a) Consider the following system of linear equations.

$$\begin{aligned} x + 2y - z &= 9 \\ 2x + 2y + 4z &= 24 \\ x + 3y - 3z &= 4 \end{aligned}$$

i. Write the system in the form of $Ax = b$.

(3 marks)

ii. Find the inverse of A using the adjoint method.

(7 marks)

(b) Solve the differential equation

$$\frac{dy}{dx} = \frac{x+1}{y^2}$$

given that $y = 2$ when $x = 1$.

(10 marks)

END OF EXAMINATION PAPER

APPENDIX

Vector

Unit Vector, $u = \frac{1}{|\vec{v}|}\vec{v}$

Angle between the vector, $\theta = \cos^{-1}\frac{\vec{u}.\vec{v}}{|\vec{u}||\vec{v}|}$

Complex Number

Polar Form: $z = r(\cos\theta + i\sin\theta)$

Modulus: $r = |z| = \sqrt{x^2 + y^2}$

Argument: $\theta = \tan^{-1}\left(\frac{y}{x}\right)$

De Moivre Theorem: $z^n = r^n(\cos n\theta + i\sin n\theta)$

Integration

$$\int 1\,dx = x + C$$

$$\int x^n\,dx = \frac{x^{n+1}}{n+1} + C, \qquad n \neq -1$$

$$\int \frac{1}{x}dx = \ln|x| + C$$

$$\int \frac{1}{x^n}dx = \frac{x^{-n+1}}{-n+1} + C, \qquad n \neq 1$$

$$\int e^x\,dx = e^x + C$$

$$\int \sin x\,dx = -\cos x + C$$

$$\int \cos x\,dx = \sin x + C$$

$$\int \tan x\,dx = ln|\sec x| + C$$

$$\int \sec x\,dx = ln|\sec x + \tan x| + C$$

$$\int \cos ax\,dx = \frac{1}{a}\sin ax + C$$

Integration Trigonometry Function

$$\int \sin u\,du = -\cos u + C$$

$$\int \cos u\,du = \sin u + C$$

$$\int e^x\,dx = e^x + C$$

$$\int e^{ax}\,dx = \frac{1}{a}e^x + C$$

By part

$$\int u\,dv = uv - \int v\,du$$

Function value

$$area = \int_a^b f(x)\,dx$$

$$V = \int_a^b A(x)\,dx$$

$$= \pi\int_a^b [f(x)]^2\,dx$$

Differentiation

$y = c\ (constant)$ $\quad \frac{dy}{dx} = 0$

$y = x$ $\quad \frac{dy}{dx} = 1$

$y = x^n$ $\quad \frac{dy}{dx} = nx^{n-1}$

$y = \sin x$ $\quad \frac{dy}{dx} = \cos(x)$

$y = \cos x$ $\quad \frac{dy}{dx} = -\sin x$

Product rule

$$\frac{dy}{dx} = v\frac{du}{dx} + u\frac{dv}{dx}$$

Quotient rule

$$\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

Integrating Factor

$$IF = e^{\int P(x)dx}$$

Matrix

$$A^{-1} = \frac{1}{|A|}adj(A)$$

$$A^{-1} = \frac{1}{|A|}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$