

071606T4IMT

INDUSTRIAL MECHATRONICS TECHNOLOGY LEVEL 6

ENG/OS/IMT/CC/02/6/A

APPLY ENGINEERING MATHEMATICS

July/August 2024



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION
COUNCIL (TVET CDACC)**

WRITTEN ASSESSMENT

TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATE:

1. This paper consists of **TWO** sections: **A** and **B**.
2. Separate answer booklet is provided.
3. Marks for each question are indicated in brackets.
4. Do not write on this question paper.
5. Answer the questions in **English**.

This paper consists of FOUR (4) printed pages

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A: (40 MARKS)*Answer ALL questions in this section*

1. Convert the equation;

(a) $r^2 = \frac{4}{4-3\cos^2\theta}$ to Cartesian form (2 marks)

(b) $x^2 + y^2 - 2x - 4y = 4$ to polar form (2 marks)

2. Determine the value P and Q which satisfy the equation;

$P \cosh x + Q \sinh x = 7e^x + 3e^{-x}$ (5 marks)

3. Solve the Algebraic equations.

a) $8^{x+1} (5^{2x-1}) = 13^{x+6}$ (4marks)

b) $\log_4(x+1) + \log_4(x-1) = 2$ (3marks)

4. The radius of a cylinder is increased by 2% while its height is decreased by 3%.

Determine the % change in the volume of the cylinder. (5marks)

5. A teacher wants to analyze the test scores of their students. The scores are as follows: 85, 92, 78, 88, 95, 84, 90, 86, 79, and 91. Calculate the median. (2marks)

6. If
- $\vec{P} = 10i - 15j + 30k$
- , find the modulus of
- $\vec{P}$
- (3marks)

7. Find the gradient of the function
- $f(x) = 3x^2 + 4x - 2$
- at the point
- $x = 2$
- . (3marks)

8. Prove the identity

$$\frac{\cos \vartheta - \cos^3 \vartheta}{\sin \vartheta} = \sin \vartheta \cos \vartheta$$
 (2 Marks)

9. Find the stationary points of the function
- $f(x) = x^3 - 6x^2 + 9x + 1$
- (6marks)

10. Determine the surface area of cylinder of diameter 14cm and height of 10.5 cm. (3marks)

SECTION B: (60 MARKS)

Answer any **THREE** questions from this section

11.

- a) Use Binomial theorem to expand $\left(\frac{1+3x}{1-3x}\right)^{1/2}$ in ascending powers of x upto the term in x^2

hence evaluate $\sqrt{\frac{13}{7}}$. (10marks)

- b) Write down the middle term of binomial expansion of $(4x - 3y)^8$ and calculate its value when $x = \frac{1}{4}$ and $y = \frac{1}{3}$ (10marks)

12.

- a) Express $\sin(x + h)$ as a series of powers of h in Taylor series and evaluate $\sin 40^\circ$ correct to 5 decimal places. (10 marks)

- b) Determine Fourier series of

$$f(x) = \begin{cases} 10 & -\pi \leq x \leq 0 \\ -1 & 0 \leq x \leq \pi \end{cases} \quad (10\text{marks})$$

13.

- a) Solve the differential equation: $\sin y \frac{\partial y}{\partial x} = \cos x (2\cos y - 1)$ by letting $V = \cos Y$. (10marks)

- b) Determine the Laplace transform of $f(t) = e^{st} \cos 4t$ from first principle. (10marks)

14.

- a) The data in table 1 shows values obtained from an experiment.

Table 1

x	-1	0	1	2	3	4
$y = f(x)$	-7	-4	-1	8	29	68

Use Newton Gregory forward interpolation formula to determine $f(x)$, and find:

(i) $f\left(-\frac{1}{2}\right)$

(ii) $f(3.6)$

(10 marks)

b) Given that $A = \begin{bmatrix} 1 & -1 & 2 \\ -2 & 1 & -2 \\ 1 & 2 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 & -1 \\ -1 & 2 & 1 \\ 1 & 1 & 3 \end{bmatrix}$

Determine:

(i) $C = AB$

(ii) C^{-1}

(10 marks)

THIS IS THE LAST PRINTED PAGE