071505T4MTP

MECHANICAL PRODUCTION TECHNICIAN LEVEL 5

ENG/OS/ME/CC/04/5/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 has **TWO** sections: **A** and **B.**
2. Answer **ALL** questions in section **A** and **THREE** questions from section **B.**
3. You are provided with a separate answer booklet.
4. Candidate should have non –programmable Scientific Calculator
5. Use **SMP TABLE** if need be.
6. Marks for each question are as indicated.
7. Do not write on the question paper.

This paper consists of FIVE (5) printed pages with FIFTEEN (15) questions.

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 the questions in this section

1. Convert the recurring decimal number 0.405 into a fraction in its lowest form. (3 Marks)
2. Solve $3x^2 - 11x - 4 = 0$ by using the quadratic formula (3 Marks)
3. Given that Cos A = $\frac{1}{\sqrt{3}}$, where A is acute, determine the other 5 trigonometry ratios of θ. (4 Marks)
4. Solve the equation:

   $3\,Cos\,2\Theta - Sin\,\Theta + 2 = 0$, for values of Θ from 0^0 to 360^0 inclusive. (4 Marks)
5. Express (6, 137°) in Cartesian co-ordinates and sketch the point on a Cartesian plane. (4 Marks)
6. Show that the polar of the Cartesian equation.

   $y^2 + 6x - 9 = 0$ is given by $r = \frac{3}{1+\cos\theta}$ (4 Marks)
7. Factorize expressions;

   $(\frac{x^4-y^4}{x^2+y^2})(\frac{1}{x-y})$ (3 Marks
8. Evaluate following expression without using a calculator:

$$\frac{\frac{2}{7} \times \frac{1}{6} \div \frac{5}{9} + \frac{3}{4} of \frac{1}{2}}{(\frac{1}{5} + \frac{2}{3}) \times \frac{1}{7} \div \frac{2}{3}}$$

   (4 Marks)
9. Solve the equation:

   $9^x \times 3^{x-5} = 81$ (3 Marks)
10. Given that OA = **a**, vector OB = **b.**

    If M divides vector AB in the ratio 1:3, determine vector OM in terms of **a** and **b**. (4 Marks)
11. Solve the equation using logarithms:

    $\text{Log}_2(3x + 6) - \log_2(5x - 4) = 3$ (4 Marks)

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SECTION B: (60 MARKS)

*Attempt **ANY THREE** questions from this section*

12.

a. Solve the value of x in the following equation.

$3^{2x+1} - 10(3^x) + 3 = 0$ (7Marks)

b. Find scalars **a** and **b** such that;

$$a\begin{pmatrix}4\\3\end{pmatrix} + b\begin{pmatrix}2\\1\end{pmatrix} = \begin{pmatrix}3\\4\end{pmatrix}$$ (4 Marks)

c. Solve the equation:

$log_3 x + log_x 9 = 3$ (9 Marks)

13.

a. Given the matrices:

$$A = \begin{bmatrix}1 & -2 & 5\\6 & 3 & -1\\7 & 2 & 1\end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix}8 & 0 & 5\\-2 & 4 & 1\\3 & 6 & 2\end{bmatrix}$$

i. Find 2A + 5B;

ii. Show that $(AB)^T = B^T A^T$

(10 Marks)

b. Three forces of a certain mechanical system satisfy the following simultaneous equation;

$F_1 + 2F_2 - 3F_3 = 40$

$2F_1 + F_2 + F_3 = 20$

$3F_1 - F_2 + 3F_3 = 15$

Solve for F_1, F_2, and F_3 using the inverse matrix method.

(10 Marks)

14.

a. Table 1 shows length in centimeters of 230 cables used in a mechanical workshop

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Table 1

Length in (cm)	70 - 80	80 - 90	90 - 100	100 - 110	110 - 120	120 -130	130 - 140	140 -150
Frequency(f)	12	18	35	42	50	45	20	8

Using an assumed mean of 105, determine the following:

i. Mean;
ii. Mode;
iii. Standard deviation. (12 Marks)

b. Table 2 shows the marks scored by 20 students taking Mechanical Technology level 5 course in mechanical engineering:

Table 2

Marks	0-5	5-10	10-15	15-20	20-25	25-30
No. of students	2	3	4	X	Y	2

Given the modal mark is 17, determine the values of X and Y. (8 Marks)

15.

a. Figure 1 below shows a solid made up of two parts of a cylindrical bottom and a conical top. The base has a radius R and height H, with a top truncated portion whose topmost radius is r and a vertical height of h from the top of the cylinder. It also has a semi-spherical base ABC as shown in figure 1. below

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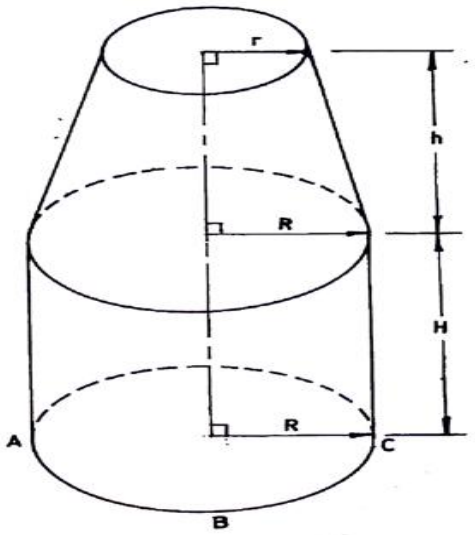

Figure 1

Taking r = 4 cm, R = 7 cm, h = 3 cm and H = 10 cm. Determine the:

i. total surface area;

ii. volume of the solid in liters. (16 Marks)

b. Use factorization method to solve the following equation:

$6x^2 - x - 1 = 0$ (4 Marks)

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