071306T4EIN

Electrical Installation Level 6

ENG/OS/EIT/CC/01/6/A

Apply Engineering Mathematics

July/August 2023

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

WRITTEN ASSESSMENT

TME: 3 HOURS

INSTRUCTIONS TO CANDIDATE

*This paper consists of **TWO** sections: **A** and **B.***

*Answer **ALL** questions in sections **A** and any **THREE** in section **B** in the answer booklet provided.*

Marks for each question are indicated in brackets

This paper consists of three (3) printed pages.

Candidate should check 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. Find the value of *x* in equation $(\mathbf{2^{x-5}})(\mathbf{5^{x+1}}) = 62.5$ (3 Marks)
2. Solve the equation, (5 Marks)

   $10Cos\theta + 4Sin\theta = 7$

   For values of θ between 0^0 and 90^0.
3. Determine the values of the constants P and Q equations,

   $Pe^{3x} - Qe^{-3x} = cosh3x + 8sinh3x.$ (3 Marks)
4. Given the vector $p = -3i + 6j + 4k$ and $q = 2i + 5j - 3k$ determine the: (4 Marks)
   a) Angle between p and q
   b) Area of the triangle spanned by p and q
5. The probability of getting a defective resistor from a factory is 0.04, a sample of 10 resistors were selected. Determine the probability of getting less than 8 non defective resistors. (4 Marks)
6. The height of a ceiling rose lamp holder in the shape of a cone is increasing at $0.3cm/s$ and its radius is decreasing at $0.2cm/s$. Determine, correct to 3 significant figures, the rate at which the volume is changing $(in\ cm^3/s)$ when the height is 3.5cm and the radius is 1.5cm. (5 Marks)
7. Use Demoivre's theorem to prove that: (3 Marks)

   $Sin\,4\theta = 4Cos^3\theta Sin\theta - 4Cos\theta Sin^3\theta$
8. Express the equation of the parabola $y^2 = 7 - x$ in the polar form. (2 Marks)
9. Find the Laplace transform of $f(t) = t\cos 4t$. (3 Marks)
10. Table 1 gives the frequency distribution of the number of orders received each day for the past 50 days. Calculate the mean. (5 Marks)

    Table 1

Number of order	10-12	13-15	16-18	19-21
Frequency	4	12	20	14

11. Find the term in x^6 in the binomial expansion of$(3x - 2)^{14}$, and determine its value where$x = \frac{1}{10}$, correct to three decimal places. (3 Marks)

SECTION B: (60 Marks)

*Answer any **THREE** Questions from this section, all questions carry equal marks.*

12. (a) A $2x2$ symmetric matrix A has eigen values $\lambda 1 = 4\ and\ \lambda 2 = -1$. Given the eigen vectors corresponding to $\lambda 1\ is\ [2 \quad 1]^T$ determine the: (12 Marks)

    i. Eigen vector corresponding to $\lambda 2$

    ii. Matrix A.

(b). Determine the Fourier sine series of the function (8 Marks)

$$f(x) = \begin{cases} -2, & when\ -\pi < x < 0 \\ 2, & when \quad 0 < x < 0 \end{cases}$$

13. (a) Use Laplace transforms to solve the differential equation; (12 Marks)

$\frac{d^2x}{dt^2} + 8\frac{dx}{dt} + 7x = 6e^{-2t}$,given that when t = 0, x = 4 and $\frac{dx}{dt} = 8$

(b) Use the D-Operator method to solve the differential equation;

$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = e^{2x}$ (8 Marks)

14. (a) Show that a better root of f(x) $f(x) = X^3 - 5X + 1$ is given by $\boldsymbol{X_n + 1 = \frac{2X_n^3 - 1}{3X_n^2 - 5}}$, $n =$ 0,1,2 ... . by taking $x_0 = 0.5$ solve the equation to 6 decimal places (10 Marks)

(b). Table 2 represent a cubic polynomial f(x):

Table 2

X	-2	-1	0	1	2	3	4	5
F(x)	-12	-3	-2	0	8	28	66	128

Use the Newton-Gregory forward difference interpolation formula to determine f(x).

(10 Marks)

15. (a) Use Maclaurin's theorem to expand $\tan(\frac{\pi}{4} + h)$ up to the term in x^3. Hence,

Determine the value of $tan\ 46^{\circ}$. (11 Marks)

(b). Expand $1 - x + x^2 - x^3$ in Taylor series about point x = -1. Hence evaluate the

Integral of $\int_0^1 \frac{1-x+x^2-x^3}{(x+1)^2} dx$ (9 Marks)

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