**071306T4EEN**

**Electrical Engineering level 6 (power option)**

**ENG/OS/PO/CC/01/6**

**Apply Engineering Mathematics**

**July/August 2023**

**Time: 3 Hours**

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

**WRITTEN ASSESSMENT**



**3 HOURS**

**INSTRUCTIONS TO CANDIDATE**

*This paper consists of **TWO** sections: **A,** and **C**.*

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

*Marks for each question are indicated in brackets.*

*Do not write on this question paper.*

*Answer the questions in **English.***

**This paper consists of THREE (3) printed pages.**

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

## SECTION A: (40 Marks)

*Answer all questions in this section*

1. Simplify the expression: ( 3Marks)

$$\frac{log125-\frac{1}{2}log25}{log625+\frac{1}{2}log25}$$

2. Solve the equations (5marks)

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

For values of $\theta$ between $0^0$ and $90^0$ inclusive.

3. Determine the values of the constants P and Q equations,

$Pe^{2x} - Qe^{-2x} = 6cosh2x + 4sinh2x.$ (3 marks)

4. Given the vector $p = -3i + 6j + 4k$ and $q = 2i + 5j - 3k$ determine the:

   a) Angle between p and q (5 marks)

   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. (5 marks)

   a) 2 defective resistor

   b) less than 8 non defective resistor



6. The height of a ceiling rose lamp holder in the shape of a cone is increasing at $0.4cm/s$ and its radius is decreasing at$0.3cm/s$. Determine, correct to 3 significant figures, the rate at which the volume is changing $(in\ cm^3/s)$ when the height is 3.4cm and the radius is 1.4cm (5marks)

7. Use Demoivre's theorem to prove that: (3marks)

$\text{Sin}\, 4\theta = 4Cos^3\theta Sin\theta - 4Cos\theta Sin^3\theta$

8. Express the equation of the parabola $y^2 = 3 - 5x$ in the polar form. (3marks)

9. Find ,from first principles, the Laplace transform of $f(t) = te^{-3t}$ (3mark)

10. Find the determinant of the matrix. (2marks)

$$\text{A}=\begin{bmatrix} 1 & -2 & 3 \\ -2 & 1 & 2 \\ 1 & 1 & -1 \end{bmatrix}$$

11. Evaluate the integrals: (3marks)

$\int_1^4 (\frac{1}{x^{-1}} + \frac{1}{x^2} + \frac{1}{x^3})dx$

## SECTION B: (60 Marks)

*Answer any **THREE** Questions from this section*

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

    i. Eigenvector corresponding to $\lambda 2$

    ii. Matrix A.

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

    $f(x) = 4x, 0 \leq x \leq \pi.$

13. (a) Use Laplace transforms to solve the differentiation equation (10marks)

    $\frac{d^2x}{dt^2} + 3\frac{dy}{dx} + 2x = 2e^{-t}$ ,given that when t = 0, x = 0and $\frac{dy}{dx} = 1$

    (b) Use the method of undetermined coefficients to solve the differential equation

    $\frac{d^2x}{dt^2} - 5\frac{dx}{dt} + 6x = e^{-4t}$ (10marks)

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 $n = 0,1,2 \ldots \ldots$ by taking $x_0 = 0.5$ solve the equation to 6 decimal places (10 marks)

    (b). Table 1 represent a cubic polynomial f(x):

Table 1

| X | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|
| F(x) | 3 | 1 | 1 | 9 | 31 | 73 | 141 | 241 | 379 |

Use the Newton-Gregory forward difference interpolation formula to determine f(x). (10marks)

15. (a) Use Maclaurin's theorem to expand $\tan(\frac{\pi}{4} + h)$ as far the term in $x^3$. Hence determine the value of $tan46^{\circ}$. (11marks)

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

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



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