

073106T4LAS

LAND SURVEY LEVEL 6

LSM/OS/LS/CC/01/6/A

Apply Engineering Mathematics

Nov/Dec 2024



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

WRITTEN ASSESSMENT

Time: 3 HOURS

INSTRUCTIONS TO CANDIDATE

1. Marks for each question are indicated in the brackets.
2. The paper consists of **TWO** sections: **A** and **B**.
3. Candidates are provided with a separate answer booklet
4. **DO NOT** write on this question paper.

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. Simultaneous equations can be used by surveyors to solve unknown variables such as coordinates of a point using measurements that are interdependent. Using elimination method solve the following simultaneous equations: (4 Marks)

$$\begin{aligned}x + 2y - z &= 2 \\2x - 3y + z &= -1 \\5x - y - 2z &= -3\end{aligned}$$

2. Probability deals with the likelihood or chance of different outcomes occurring and is essential for analyzing uncertainties. Land survey section has four lecture rooms. The probability that any one lecture room is unoccupied is $\frac{1}{7}$. Find the probability that:

i. Any three of the four lecture rooms are unoccupied; (2 Marks)

ii. All the lecture rooms are occupied. (2 Marks)

3. Maclaurin series is used to approximate complex functions with polynomials, making them easier to work with in calculations. Use Maclaurin's series to find the expansion of $(2 + x)^4$ (5 Marks)

4. To calculate the change of elevation between two points, surveyors use trigonometric functions after measuring the vertical angles. Prove that $\sin x + \sin 2x + \sin 3x = \sin 2x (1 + 2 \cos x)$ (3 Marks)

5. Binomial expansion is very useful to surveyors when dealing with approximations and complex expressions involving distances, areas and volumes. Use Pascal's triangle to expand $(x^2 - y)^4$ (4 Marks)

6. Integration is vital in surveying for determining the area of irregularly shaped plots of land and computing volumes of earthworks. Evaluate $\int \frac{1}{x^2-9} dx$ (4 Marks)

7. Complex numbers offer an efficient way to handle geometric problems in land surveying such as transformations. Find the value of $\frac{2-j}{3+j} + \frac{2+j}{3-j}$ (3 Marks)

8. As a surveyor, understanding logarithms enables to handle complex scenarios efficiently and accurately. Evaluate: (3 Marks)

$$\frac{\log 25 - \log 125 + \frac{1}{2} \log 625}{3 \log 5}$$

9. The cartesian form is a way of representing points, lines and shapes using the cartesian coordinates system. Solve for Z in the equation $z^2 = 7i$ expressing your answer in the cartesian form (5 Marks)

10. Vectors are essential for analyzing spatial relations, directions and magnitudes. Given triangle ABC such that A (1, 2, 1), B (3, 5, 1) and C (4, -5, 2). Use vector method to determine the area of triangle ABC. (5 Marks)

SECTION B (60 MARKS)**Answer Any THREE Questions in This Section**

11.

- a) Matrices is a tool used in surveying for organizing and manipulating data, performing transformations and solving systems of equations. Given the matrices:

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 4 \\ 1 & 2 & 3 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2 & 2 & 1 \\ 0 & 3 & 1 \\ 0 & 5 & 1 \end{bmatrix}. \text{ Determine}$$

- i. $6A-3B$ (3 Marks)
 - ii. $\text{Det}(AB)^T$ (5 Marks)
- b) Use the matrices in the equations below to determine the value of the constants K_1 , K_2 and K_3 . (12 Marks)

$$3K_1 - 2K_2 + 4K_3 = 9$$

$$-6K_1 + 4K_2 + K_3 = 18$$

$$5K_1 + 3K_2 + 6K_3 = 25$$

12.

- a) Probability helps in analyzing random events and making informed decisions based on the likelihood of different outcomes. The probability that a person reacts to the newly manufactured vaccine against the new pandemic is 0.002. If 4000 people are vaccinated, find the probability that:

- i. No one will react to the vaccine
 - ii. Exactly 1 person will react to the vaccine
 - iii. Exactly 2 people will react to the vaccine
 - iv. At least 3 people will react to the vaccine
 - v. At most 2 people will react to the vaccine (12 Marks)
- b) Find the area enclosed between the curve $y = 2x^2 + 3x + 2$ and $y + x = 8$ (8 Marks)

13. Land surveyors use statistical methods for accurate measurement and data analysis. The following are the scores of students in a particular class

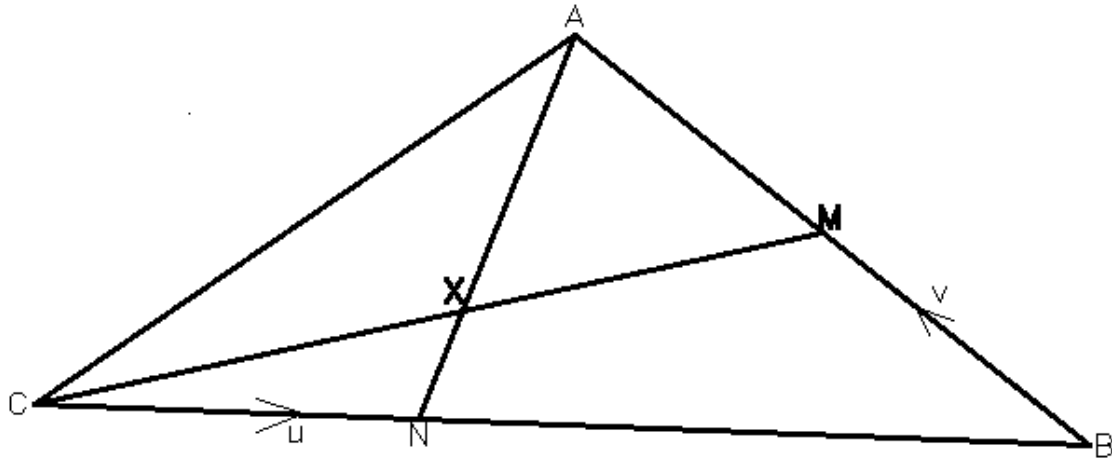
Scores	40-45	34-39	28-33	22-27	16-21	10-15
Frequency	3	1	4	5	2	5

Use the data given above to calculate:

- i. Mean (8 Marks)
- ii. Variance (11 Marks)
- iii. Standard deviation (1 Mark)

14. Vectors are crucial in land surveying for accurately measuring and mapping land areas.

In the diagram $CB=4CN$ and $NA = 5NX$. M is the midpoint of AB . $\overrightarrow{CN} = \mathbf{u}$ and $\overrightarrow{BM} = \mathbf{v}$.



a) Express the following vectors in terms of $\mathbf{u}$ and $\mathbf{v}$

i. $\overrightarrow{NB}$ (2 Marks)

ii. $\overrightarrow{NA}$ (2 Marks)

b) Show that $\overrightarrow{CX} = \frac{2}{5}(4\mathbf{u} + \mathbf{v})$ (3 Marks)

c) Calculate the value of

i. $\frac{CX}{CM}$ (2 Marks)

ii. $\frac{\text{Area } ACX}{\text{Area } ACM}$ (2 Marks)

d) The total surface area of a cone is given by $A = \pi r^2 + \pi r\sqrt{r^2 + h^2}$. If the radius r is increasing at the rate of 0.3cm/s and the perpendicular height h is decreasing at the rate of 1cm/s; find the rate of the change at the instance where $r = 5$ cm and the height $h = 12$ cm. (9 Marks)