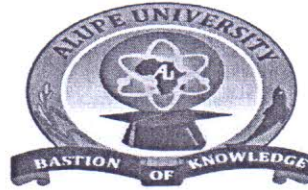


MAT 104



**ALUPE UNIVERSITY**

OFFICE OF THE DEPUTY VICE CHANCELLOR ACADEMICS,

RESEARCH AND STUDENT AFFAIRS

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**UNIVERSITY**  
**EXAMINATIONS 2023/2024**  
**ACADEMIC YEAR**

**FIRST YEAR FIRST SEMESTER REGULAR MAIN EXAMINATION**

**FOR THE DEGREE OF BACHELOR OF  
EDUCATION SCIENCE/ARTS**

**COURSE CODE:           MAT 104**

**COURSE TITLE:   BASIC MATHEMATICS AND ANALYTIC GEOMETRY**

**DATE: 6TH DECEMBER 2023**

**TIME: 9.00AM - 12.00PM**

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**INSTRUCTION TO CANDIDATES**

- SEE INSIDE

THIS PAPER CONSISTS OF 4 PRINTED PAGES

PLEASE TURN OVER

**INSTRUCTION TO CANDIDATES**

- i. Answer ALL Questions from Section A and any THREE from Section B
- ii. Do not Write on the Question Paper
- iii. Answers Should be Comprehensive, Informative and Neat

**SECTION A (31 MARKS): Answer ALL Questions in this Section****QUESTION ONE (16 MARKS)**

- a) Define the terms:
  - (i) Median as referred to in geometry (1 mark)
  - (ii) Momentum (1 mark)
- b) Find the equation of the line through the point  $(1,2)$  perpendicular to the line  $3x + 4y = 7$  (2 marks)
- c) Express the equation  $x^2 = 4y$  in polar coordinates (2 marks)
- d)  $\triangle OAB$  has vertices  $(0,0), (-3,9)$  and  $(12,4)$ . Show that  $\triangle OAB$  is a right angle (3 marks)
- e) Determine if the sets of vectors below are parallel or not:  $\vec{a} = (2, -4, 1)$  and  $\vec{b} = (-6, 12, -3)$  (2 marks)
- f) Determine the centre and the radius of the circle passing through points  $(4,3), (0,1)$  and  $(1,0)$  (5 marks)

**QUESTION TWO (15 MARKS)**

- a) Write the line  $L$  through the point  $P(3,4,5)$  and parallel to the vector  $V = (5, -2, 7)$  in:
  - (i) Vector form (1 mark)
  - (ii) Parametric form (1 mark)
  - (iii) Symmetric form (1 mark)
- b) Find the equation of the plane containing the points  $A(6, -7, -3)$ ,  $B(3, -3, 2)$  and  $C(7, 4, 2)$  (5 marks)
- c) Find the length of the curve  $y = 10 \cosh \frac{x}{10}$ , between  $x = -1$  and  $x = 2$  (7 marks)

**SECTION B (39 MARKS): Answer any THREE Questions from this Section****QUESTION THREE (13 MARKS)**

- a) A 325kg motorcycle is moving at 140km/h.
  - (i) Find its momentum (2 marks)

- (ii) At what velocity is the momentum of  $1754\text{kg}$  car equal to that of the motorcycle? **(3 marks)**
- b) Find the area enclosed between the curves  $r_1 = 1 + \sin \theta$  and  $r_2 = 3 \sin \theta$  **(4 marks)**
- c) A model of a car moves from a circular track of radius  $0.4\text{m}$  at 2 revolutions per second. What is its:
- (i) Period  $T$  **(2 marks)**
- (ii) Angular velocity  $\omega$  **(2 marks)**

**QUESTION FOUR (13 MARKS)**

- a) A stone is projected vertically upwards with a velocity of  $30\text{ms}^{-1}$  from the ground. Calculate:
- (i) the time it takes to reach maximum height **(2 marks)**
- (ii) maximum height **(2 marks)**
- (iii) velocity with which it lands on the ground **(2 marks)**
- b) Determine the angle between  $\vec{A} = (3, -4, -1)$  and  $\vec{B} = (0, 5, 2)$  **(4 marks)**
- c) Find the projection of the vector  $\vec{A} = i - 2j + k$  on the vector  $\vec{B} = 4i - 4j + 7k$  **(3 marks)**

**QUESTION FIVE (13 MARKS)**

- a) Obtain the equation of the plane with normal vector  $\begin{pmatrix} 2 \\ -3 \\ 1 \end{pmatrix}$  containing the point  $(4, 0, -3)$  **(4 marks)**
- b) Find the distance between the parallel planes whose equations are  $4x - 4y + 2z + 6 = 0$  and  $6x - 6y + 3z + 4 = 0$  **(4 marks)**
- c) Find the equation of the tangent to the ellipse:  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  at  $(a \cos \theta, b \sin \theta)$  **(5 marks)**

**QUESTION SIX (13 MARKS)**

- a) A ball of mass  $35\text{g}$  travelling at  $20\text{ms}^{-1}$  strikes a wall at right angles and rebounds with a speed of  $16\text{ms}^{-1}$ . Find the impulse exerted on the ball **(4 marks)**
- b) Find the point of intersection between the following lines  $\frac{x+1}{3} = \frac{y-2}{2} = \frac{z-1}{-1}$  and  $x+3 = \frac{y-8}{-3} = \frac{z+3}{2}$  **(4 marks)**
- c) Sketch the curve given parametrically by  $x = \sin \theta, y = \sin 2\theta$ . **(5 marks)**