



*(Knowledge for Development)*

**KIBABII UNIVERSITY**  
**UNIVERSITY EXAMINATIONS**  
**2020/2021 ACADEMIC YEAR**  
**SECOND YEAR SECOND SEMESTER**  
**SPECIAL/SUPPLEMENTARY EXAMINATION**  
**FOR THE DEGREE OF BACHELOR OF EDUCATION AND**  
**BACHELOR OF SCIENCE**

**COURSE CODE:** MAT 224

**COURSE TITLE:** ANALYTIC GEOMETRY

**DATE:** 20/01/2022

**TIME:** 11:00 AM – 1:00 PM

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**INSTRUCTIONS TO CANDIDATES**

Answer Question One and Any other TWO Questions

TIME: 2 Hours

### QUESTION ONE (30 MARKS)

- a) Convert the parametric equation  $x = 3 + \sqrt{3} \cos \theta$  and  $y = -2 + \sqrt{3} \sin \theta$ , into Cartesian form, and hence identify the curve (3 marks)
- b) If  $y = \left(-\frac{4}{9} + x\right)^{\frac{3}{2}}$ . Find the length of the curve between  $y = 0$ , and  $y = 1$  (3 marks)
- c) A point P divides a line through (3, 1, 4) and (8, 11, 9) in the ratio 3:2. Find coordinates of the point Q. (3 marks)
- d) Show that the planes  $2x - 4y + 3z + 6 = 0$  and  $-6x + 12y - 9z - 2 = 0$  are parallel and hence find the shortest distance between them (Give your answer to two decimal places. (4 marks)
- e) Find the angle between the lines whose direction ratios are (2, 3,1) and (3, 4, 2). (3 marks)
- f) Sketch the curve whose equations are  $(x + 4)^2 = -12(y + 1)$ . (4 marks)
- g) Identify the surface for each of the following equations. (4 marks)
- $r^2 + z^2 = 100$
  - $z = r$
- h) Perform each of the following conversion
- Cylindrical coordinates  $(\sqrt{6}, \frac{\pi}{4}, \sqrt{2})$  to spherical coordinates (3 marks)
  - Cartesian coordinates  $(-1, 1, -\sqrt{2})$  to spherical coordinates (3 marks)

### QUESTION TWO (20 MARKS)

A plane P has three points (2, 5, 6), (2, 1, 8) and (3, 4, 7). The plane intersects with a line through points (2, 1, 4) and (4, 3, 8) at point M. Find;

- the equation of the plane (5 marks)
- equation of the line in parametric form (3 marks)
- the coordinates of M (3 marks)
- the ratio in which the plane divides the line (5 marks)
- any vector parallel to the plane (4 marks)

### QUESTION THREE (20 MARKS)

- a) Given the equation of an ellipse  $9x^2 - 18x + 25y^2 + 100y = 116$
- write the equation in standard form (3 marks)
  - find the foci, center, the vertices of the curve and hence sketch it (5 marks)
  - if the ellipse was translated 5 units to the right and 2 units up, what would be its new equation? (2 marks)
- b) Two ellipses  $4x^2 + 5y^2 = 81$  and  $5x^2 + 4y^2 = 81$  intersect at different points. Find the points of intersection (5 marks)
- c) Sketch the hyperbola  $\frac{x^2}{16} - \frac{y^2}{9} = 1$  and its asymptotes (5 marks)

#### QUESTION FOUR (20 MARKS)

- a) Using a simple sketch, derive the relationship between
- Cartesian and spherical coordinates (4 mark)
  - Cartesian and cylindrical coordinates (4 marks)
- b) Carry out the following conversion, simplify your answers
- The Cartesian equation  $x^3 + 2x^2 - 6z = 4 - 2y^2$  to cylindrical coordinates (3 marks)
  - The Cartesian equation  $x^2 + y^2 = -z^2 - 2$  to cylindrical coordinates (3 marks)
  - The Cartesian coordinates  $(2, 1, 4)$  to cylindrical and spherical coordinates (6 marks)

#### QUESTION FIVE

- (a) Given lines whose direction ratios are given by the relations  $l + m + n = 0$  and  $l^2 + m^2 - n^2 = 0$ , find the angle between the lines. (8marks)
- (b) Find the equation of the locus of the point whose distance from the point  $(2, -2, 2)$  is two times its distance from the plane  $2x + 3y - 6z = 12$  (5marks)
- (c) Find the coordinates of the point where a line through  $(3, -4, -5)$  and  $(2, -3, 1)$  crosses the plane  $2x + y + z = 7$  (7marks)