



## UNIVERSITY EXAMINATIONS

**FIRST YEAR EXAMINATION FOR THE AWARD OF DEGREE  
OF BACHELOR OF EDUCATION SCIENCE**

**MATH 124: GEOMETRY AND LINEAR ALGEBRA****STREAMS: BED (SCI) P/T****TIME: 2 HOURS****DAY/DATE: WEDNESDAY 15/04/2020****2.30 P.M. – 4.30 P.M.****INSTRUCTIONS: Answer question ONE and any other TWO questions****QUESTION ONE (30 MARKS)**

- (a) Find the slope  $m$ , x-intercept  $a$ , and y-intercept  $b$  of the line given below  
 $5x + 2y + 2 = 0$  [4 marks]
- (b) Find the distance between the point  $(4,1)$  and the line  $y = 2x + 1$  [3 marks]
- (c) Find the centre and radius of the circle  $2y^2 + 12x + 2x^2 - 18y + 34 = 0$  [4 marks]
- (d) Convert the following polar coordinates into Cartesian coordinates [4 marks]
- (i)  $(5, -40^\circ)$
- (ii)  $(6, 200^\circ)$
- (e) Given that  $Z = 2 + 3i$  and  $\frac{Z}{z} = a + bi$ , determine the values of  $a$  and  $b$ . [4 marks]
- (f) Determine  $\alpha$  given that  $\underline{a} = \alpha \underline{i} - 2\underline{j} + \underline{k}$  and  $\underline{b} = 2 \alpha \underline{i} + \alpha \underline{j} - 4\underline{k}$  are orthogonal. [4 marks]
- (g) Given  $B = \begin{pmatrix} 3 & 5 \\ 2 & -3 \\ 0 & 2 \end{pmatrix}$  and  $C = \begin{pmatrix} 4 & 5 \\ -2 & 0 \end{pmatrix}$  Find  $B^T B + 3C$  [4 marks]
- (h) Find the angle between the vectors  $\underline{a} = 6i + 2j + k$  and  $\underline{b} = -2i + 3j - k$  [4 marks]

## MATH 124

### QUESTION TWO (20 MARKS)

- (a) Two lines  $L_1$  and  $L_2$  have equations  $-\frac{1}{2}x = -4 - y$  and  $3y = 4x - 10$  respectively.
- Find the point of intersection of the two lines
  - $L_3$  is a line passing through the point where  $L_1$  and  $L_2$  intersect and is perpendicular to  $L_2$ . Find the equation of  $L_3$
  - Calculate the acute angle between  $L_1$  and  $L_3$  [10 marks]
- (b) Given the equation of an ellipse  $25x^2 + 9y^2 - 150x - 72y + 144 = 0$   
Find the
- Centre, foci and eccentricity
  - The coordinates of the vertices and equations of the directrices [10 marks]

### QUESTION THREE

- (a) Calculate the centre and radius of a circle which passes through the points  $A(0, 2), B(2, 2), C(-2, -2)$ . Hence find the equation of the circle. [8 marks]
- (b) Show that the shortest distance between point  $P_1(x_1, y_1)$  and the line  $Ax + By + c = 0$  is given by
- $$d = \frac{Ax_1 + By_1 + c}{\sqrt{A^2 + B^2}} \quad [7 \text{ marks}]$$
- (c) Given  $A = \begin{pmatrix} 1 & 0 & 3 \\ 2 & 1 & 0 \\ 2 & 1 & 1 \end{pmatrix}$  find  $A^{-1}$  using matrix determinant method [5 marks]

### QUESTION FOUR

- (a) Use matrices to solve the simultaneous equations below [10 marks]
- $$\begin{aligned} x + 2y + 3z &= 5 \\ 2x - 3y - z &= 3 \\ -3x + 4y + 5z &= 3 \end{aligned}$$
- (b) A parabola is defined by the curve  $y^2 - 6y - 4x + 1 = 0$
- Show that the curve is of the form  $(y - k)^2 = 4c(x - h)$
  - Identify  $V$  the vertex of the parabola and its axis of symmetry
  - State the coordinates of focus  $F$ ,
  - Sketch the parabola and locate the directrix [10 marks]

**QUESTION FIVE (20 MARKS)**

- (a) Solve the following simultaneous equations using Cramer's rule [7 marks]

$$x + y + z = 4$$

$$2x - 3y + 4z = 33$$

$$3x - 2y - 2z = 2$$

- (b) A hyperbola whose centre is  $(2, 3)$  has its foci  $\sqrt{13}$  units away from the centre along an axis parallel to the y-axis. Given further that the vertices are 2 units away from the centre, find:

- (i) The equation of the hyperbola in the form

$$Ax^2 + Bxy + cy^2 + Dx + Ey + F = 0$$

- (ii) State the equation of the asymptotes on the XY plane [8 marks]

- (c) A curve is defined by  $x^2 + y^2 - 8y - 6x = 0$

- (i) Show that the curve defines a circle

- (ii) Locate the centre C and radius r of the circle [5 marks]

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