**MACHAKOS UNIVERSITY**

**ISO 9001:2008 Certified**

**UNIVERSITY EXAMINATIONS 2019/2020**

UNIVERSITY SUPPLEMENTARY EXAMINATIONS

**FOR THE DEGREE OF BACHELOR OF SCIENCE STATISTICS AND PROGRAMMING AND ACTUARIAL SCIENCE**

**SST 103: LINEAR ALGEBRA**

**NSTRUCTIONS TO CANDIDATES**

**(a) Answer ALL the questions in Section A and ANY TWO Questions in Section B**

## SECTION A

**QUESTION ONE 30 Marks (Compulsory)**

a) Find the angle between the following vectors $4i + 4j + 6k$ and $i + 2j + 2k$ (4 marks)

b) Solve the homogenous system by Gauss elimination method

$$2x - 4y + 6z = 20$$
$$3x - 6y + z = 22$$
$$-2x + 5y - 9z = 18$$

(5 marks)

c) If $\begin{vmatrix} 4y & 20 \\ 4y & 8y+4 \end{vmatrix}$=8 find y (3 marks)

Calculate the cross product of the vectors $\vec{u} = (2, 2, 3)$ and $\vec{v} = (-1, 1, 3)$. (3 marks)

d) Find the inverse of the following matrix

$$\begin{bmatrix} 1 & 3 & 2 \\ 2 & 4 & 2 \\ 1 & 2 & -1 \end{bmatrix}$$

(4 marks)

e) Show that the vector (2,-6,3) is a linear combination of the (3,-5,4) and (1,-2,-1)

f) Calculate the x and y values for the vector (x, y, 1) that is orthogonal to the vectors (3, 2, 0) and (2, 1, –1). (4 marks)

g) Determine if (1,2,2,1), (2,3,4,1) and (3,8,7,5) is linearly dependent (4 marks)

h) Find the dot product of the following vectors $(3,4,-1)$ and $(4,6,1)$ (3 marks)

## SECTION B

### QUESTION TWO 20 MARKS

a) Let $T: R^2 \to R$ be defined by $T(x, y) = x + y$. Is T a linear map? (7 marks)

b) Let $T: R^2 \to R^2$ be defined by $T(x, y) = \{x + y, x\}$. Find the kernel of T (5 marks)

c) Let $T: R^3 \to R^2$ be the linear mapping defined by

$T(x, y, z) = (x + 2y - z, y + z, x + y + z)$. Find the basis and dimension of

i). Image of T

ii). Kernel of T (8marks)

### QUESTION THREE 20 MARKS

a) Find the equation of the plane passing through the point $(3, -1, 7)$ and perpendicular to the vector $n = (4,2,-5)$ (5 marks)

b) Find the distance from the origin to the plane $2x + 3y - z = 2$ (5 marks)

c) Find the parametric equations for the line of intersection of the plane

$3x + 2y - 4z - 6 = 0$ and $x - 3y - 2z - 4 = 0$ (5 marks)

d) Find the distance D between the point $(1, -4, -3)$ and the plane $2x - 3y + 6z = -1$

(5 marks)

### QUESTION FOUR 20 MARKS

a) Show that $w = \{ (x, y, z) | x + y + z = 0)\}$ is a subspace of $\mathbb{R}^3$ (5 marks)

**b)** Show that the vectors u=(1,-1,0) v=(1,3,-1) and w=(5,3,-2) are linearly dependent.
. (5 marks)

**c)** Find the rank of the following matrix

$$\begin{bmatrix} 2 & 4 & 3 \\ 3 & -3 & 2 \\ 2 & 0 & 3 \end{bmatrix}$$ (5 marks)

d) Solve by crammer's Rule

$$x - 2y + 3z = 10$$

$$3x - 6y + z = 22$$

$$-2x + 5y - 2z = -18$$

(5 marks)

**QUESTION FIVE 20 MARKS**

a) Define a vector space (6 marks)

b) Show that W= $\{(x, y) \ / \ x = 2y\}$ is a subspace for $R^2$. (4 marks)

c) Prove that the diagonals of a rhombus are perpendicular. (5 marks)

d) Find the parametric and the symmetric equations of the line passing through the point $(2, 3, -4)$ and parallel to the vector $(3,5,-6)$ (5 marks)