



MACHAKOS UNIVERSITY

ISO 9001:2008 Certified 

UNIVERSITY SUPPLEMENTARY EXAMINATIONS

SCO 109: LINEAR ALGEBRA FOR COMPUTER SCIENCE

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

b) Find the cross product of the following vectors $(2, 4, 6)$ and $(-3, 6, 1)$ (3 marks)

c) Reduce the following matrixes to be reduced echelon form

$$A = \begin{pmatrix} 3 & 4 & -1 & 1 \\ 1 & -1 & 3 & 2 \\ 4 & -3 & 11 & 2 \end{pmatrix} \quad (3 \text{ marks})$$

d) Solve the following system of equation by Gauss elimination method

$$x_1 + x_2 + x_3 = 5$$

$$x_1 + 2x_2 + 3x_3 = 10$$

$$2x_1 + x_2 + x_3 = 6 \quad (5 \text{ marks})$$

e) Find the equation of the plane through $(-1, 2, 3)$ and perpendicular to the planes $2x - 3y + 4z = 1$ and $3x - 5y - 5z = 16$ (5 marks)

f) Calculate the dot product of the vectors $\vec{u} = (2, 2, 3)$ and $\vec{v} = (-1, 1, 4)$. (3 marks)

g) Find the inverse of the following matrix

$$\begin{bmatrix} 3 & 2 & 2 \\ 2 & 4 & 2 \\ 3 & 3 & 1 \end{bmatrix} \quad (4 \text{ marks})$$

h) Show that the vector $(22, 6, -16)$ is a linear combination of the $(2, 2, 0)$ and $(4, 2, -2)$ (5 marks)

SECTION B

QUESTION TWO 20 MARKS

- a) 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)
- b) Determine if (1,2,3,1), (2,2,1,3) and (-1,2,7,3) is linearly dependent (5 marks)
- c) Find the angle between $u = 2i + 2j + 2k$ and $v = i + j + k$ (3 marks)
- d) Find the rank of the following matrix

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

- e) Find the minors, cofactors and adjoint of the following matrix

$$\begin{bmatrix} 2 & 3 & 1 \\ 2 & 3 & 2 \\ 1 & 3 & 1 \end{bmatrix} \quad (4 \text{ marks})$$

QUESTION THREE 20 MARKS

- a) Solve by crammer's Rule

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

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

$$-2x + 5y - 2z = -18 \quad (5 \text{ marks})$$

- b) Determine the value of 'a' so that the following systems in unknown x, y and z has
- No solution
 - More than one solution
 - Unique solution

$$\begin{aligned} x - 3z &= -3 \\ 2x + ay - z &= -2 \\ x + 2y + az &= 1 \end{aligned} \quad (6 \text{ marks})$$

- c) Find the distance D between the point (1, -4, -3) and the plane $2x - 3y + 6z = -1$ (5 marks)

QUESTION FOUR 20 MARKS

- a) Define a vector space (6 marks)
- b) Show that $W = \{(x, y) / x = 2y\}$ is a subspace for $\mathbb{R}^2$. (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)

QUESTION FIVE 20 MARKS

- a) Define a Linear mapping (2 marks)
- b) Let $T: R^2 \rightarrow R^2$ be defined by $T(x, y) = \{x + y, x\}$. Find the kernel of T (5 marks)
- c) Let $T: R^3 \rightarrow R^2$ 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)
- d) Show that the vectors $u=(1,-1,0)$ $v=(1,3,-1)$ and $w=(5,3,-2)$ are linearly dependent. (5 marks)