MACHAKOS UNIVERSITY

University Examinations 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE & CLOUD COMPUTING)

BACHELOR OF SCIENCE (STATISTICS AND PROGRAMMING)

SCO 109/SST103: LINEAR ALGEBRA FOR COMPUTER SCIENCE/LINEAR ALGEBRA

DATE: 12/4/2023 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS TO CANDIDATES

Answer QUESTION ONE and ANY OTHER TWO Questions

QUESTION ONE (COMPULSORY) (30 Marks)

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

b) Determine the angle between the following vectors $3i + 4j + 6k$ and $i + 2j + k$

(4 marks)

c) Solve the system of equations by Gauss elimination method

$$x + 2y + z = 4$$
$$3x + 8y + 7z = 20$$
$$2x + 7y + 9z = 23$$

(5 marks)

d) If $\begin{vmatrix} 2y & 10 \\ 2y & 4y+2 \end{vmatrix} = 4$ solve for y (3 marks)

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

f) Determine the inverse of the following matrix

$$\begin{bmatrix} 0 & 2 & 4 \\ 2 & 4 & 2 \\ 3 & 3 & 1 \end{bmatrix}$$

(4 marks)

g) Show that the vector (11,3,-8) is a linear combination of the (1,1,0) and (2,1,-1) (2 marks)

h) 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). (3 marks)

i) Determine if (1,2,3,1), (2,2,1,) and (-1,2,7,3) is linearly dependent (3 marks)

QUESTION TWO 20 MARKS

a) Solve by crammer's Rule

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

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

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

(5 marks)

b) Determine the inverse of the following matrix

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

(5 marks)

c) Solve the following system of equation by elimination method

$$x_1 + x_2 + x_3 = 5$$

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

$$2x_1 + x_2 + x_3 = 6$$

(5 marks)

d) Determine the rank of the following matrix.

$$\begin{pmatrix} 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 2 \\ 2 & 1 & 1 & 0 \end{pmatrix}$$

(5 marks)

QUESTION THREE 20 MARKS

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

b) Calculate the value of k for the vectors $\vec{u} = (1, k)$ and $\vec{v} = (-4, k)$ knowing that they are orthogonal. (5 marks)

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

d) Determine the rank of the following matrix

$$\begin{bmatrix} 2 & 4 & 3 \\ 3 & -3 & 2 \\ 2 & 0 & 3 \end{bmatrix}$$

(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 R^2. (4 marks)

c) Solve the following simultaneous equation using inverse matrix method

$$2x - y = 4$$

$$3x + 2y = 6$$

(5 marks)

d) Reduce the following matrix into echelon form

$$\begin{pmatrix} 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 2 \\ 2 & 1 & 1 & 0 \end{pmatrix}$$

(5 marks)

QUESTION FIVE 20 MARKS

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

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

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