KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2020/2021 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER EXAMINATIONS

(SUPPLEMENTARY/SPECIAL EXAMS)

FOR THE DEGREE OF

BACHELOR OF SCIENCE CMPUTER SCIENCE

COURSE CODE: MAT 212

COURSE TITLE: LINEAR ALGEBRA I

DATE: 30/9/2021 TIME: 2:00 PM - 4:00 PM

INSTRUCTIONS TO CANDIDATES

- Answer question ONE (COMPULSORY) and any other TWO questions

This Paper Consists of 5 Printed Pages. Please Turn Over.

QUESTION ONE (30 MARKS)

a) Define the following terms:

i) Trace of matrix (1 mk)

ii) Linear combination of a vector (2 mks)

iii) Transpose of a matrix (1 mk)

iv) Vector space (2mks)

b) Let A and B be invertible matrices. Prove that $(AB)^{-1}=B^{-1}A^{-1}$ (3 marks)

c) Let AX=B be system of linear equation. Show that if A^{-1} exists , the solution is unique and is given by $X=A^{-1}B$ (3marks)

d) Prove that the following transformation hT: $R^2 \rightarrow R^2$ is linear. **T (x, y) = (2x, x + y)** (4 mks)

e) Find AB given that

$$A = \begin{bmatrix} Cos\,\theta & -\sin\theta \\ Sin\,\theta & Cos\,\theta \end{bmatrix},\ B = A^T$$ (3 mks)

f) Use the row reduction formula to find the inverse of the matrix

$$A = \begin{bmatrix} 3 & 2 & 1 \\ 4 & 1 & 3 \\ 2 & 1 & 6 \end{bmatrix}$$ (8 mks)

g) Determine the basis of the matrix B below;

$$B = \begin{pmatrix} 1 & -3 & 2 \\ -2 & 6 & -4 \\ -1 & 3 & -2 \end{pmatrix}$$ (3marks)

QUESTION TWO (20 MARKS)

a) Given the matrix

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

Determine:

i) The determinant of A

ii) The matrix of the minors

iii) The adjoint of the co-factors of A

iv) Inverse of A

(12mks)

Determine whether the function $f(x)=x^2+4x+5$ is a linear combination of the functions $g(x)=x^2+x-1$ and $(x)=x^2+2x+1$ (5marks)

c) Determine the rank of the matrix

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 2 & 5 & 8 \end{bmatrix}$$

(3mks)

QUESTION THREE (20MARKS)

a) Use the Cramer's rule to solve the following system of linear equations.

$$x + y + z = 6$$
$$2x + y = 4$$
$$2x + 3y + z = 11$$

(10 mks)

b) Use Gaussian elimination to solve the system of equations

$$2x - y + z = 1$$
$$2x + 2y + 2z = 2$$
$$-2x + 4y + z = 5$$

(6mks)

c) Determine whether the set defined by the vector $(a, b, 2a + 3b)$ Is a subspace of $\mathbb{R}^3$ (4 mks)

QUESTION FOUR(20MARKS)

a) If $A = \begin{pmatrix} 1 & 2 & 3 & 2 \\ 5 & 6 & 7 & 2 \\ 8 & 9 & 10 & 7 \end{pmatrix}$, $B = \begin{pmatrix} 1 & 2 \\ 5 & 6 \\ 8 & 9 \\ 3 & 7 \end{pmatrix}$, Find AB (5 mks)

b) Find the determinant of matrix below by reducing it first to an upper triangular matrix.

$$A = \begin{pmatrix} 1 & -1 & 1 \\ 0 & 1 & 1 \\ 2 & 1 & -1 \end{pmatrix}$$

(5mks)

c) State (with brief explanation) whether the following statement is true or false. The vectors (1, 0, 0), (0, 2, 0), (1, 2, 0) span $\mathbb{R}^3$ (5 mks)

d) Determine whether the vectors (1, 2, 0), (0, 1, - 1), (1, 1, 2) are linearly independent in $\mathbb{R}^3$ (5 mks)

QUESTION FIVE(20MARKS)

a) Express $V = (1, -2, 5)$ in $\mathbb{R}^3$ as a linear combination of the vectors $\mathbf{u}_1 = (1, 1, 1)$, $\mathbf{u}_2 = (1, 2,3)$ and $\mathbf{u}_3=(2, -1, 1)$ (6 mks)

b) i) Define the basis of a vector space. (2 mks)

ii) Prove that the vectors (1, 1, 1), (0, 1, 2) and (3, 0, 1) form a basis for $\mathbb{R}^3$ (6 mks)

c) i) Define linear transformation. (2 mks)

ii) Verify for the transformation defined by the matrix $A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ that

$A(V_1 + V_2) = AV_1 + AV_2$ (4 mks)