THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

(A Centre of Excellence)

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MECHANICAL & AUTOMOTIVE ENGINEERING

SMA 2379: LINEAR & BOOLEAN ALGEBRA

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2012
TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*

This paper consist of **FIVE** questions in **TWO** sections **A** & **B**
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) Define the following terms:

(i) A tautology. **(1 marks)**

(ii) Matrix **(1 mark)**

(iii) Orthogonality **(1 mark)**

b) Use your knowledge of the truth table to determine the truth values of the following compound statement: **(4 marks)**

$2+3=5$ and $1+1=3$ State the properties of electrostatic forces.

c) If $\underset{\sim}{a}=4i+3k$ and $\underset{\sim}{b}=-2i+j+5k,$ find:

(i) $\left|\underset{\sim}{a}\right|$ **(2 marks)**

(ii) $\left|2\underset{\sim}{a}+3\underset{\sim}{b}\right|$ **(3 marks)**

d) Using vector methods, find the distance d between $p(4,3)$ and the line $L; x+3y=6$ **(5 marks)**

e) (i) State any **THREE** properties of a determinant of matrix. **(3 marks)**

(ii) Determine the determinant of the matrix below. **(2 marks)**

$$B=\begin{bmatrix} b11 & b12 & n13 \\ b21 & b22 & b23 \\ b11 & b12 & b13 \end{bmatrix}$$

f) Find an equation for the plane through the points $A(0,0,1)$ $B(2,0,0)$ and $C(0,3,0)$ **(5 marks)**

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

g) Find the eigen values of **(3 marks)**

Question Two

a) If $\underset{\sim}{a}=2i+3j-6k$ and $\underset{\sim}{b}=i+2j-2k$, calculate $\underset{\sim}{a}\times\underset{\sim}{b}$ **(3 marks)**

b) Find an equation for the line through $Po(3,5)$ and perpendicular to $\vec{N}=i+2j$ **(4 marks)**

c) Find the area of the triangle whose vertices are $A(1,-1),01,\ B(2,1,-1)$ and $C(-1,1,2)$ **(5 marks)**

d) Find a unit vector perpendicular to both $A=2i+j-k$ and $B=i-j+2k$ **(3 marks)**

$x^2 + 2y^2 = 6$

e) Find the unit vectors that are tangent and normal to the curves at the given point: at $(2,1)$

(5 marks)

Question Three

$A - B = A \cap B^1$

a) Show that **(5 marks)**

b) Define the following terms:

(i) Logic **(1 mark)**

(ii) Proposition **(1 mark)**

(iii) Construct a truth table for the following statement. (8 marks)

$P \rightarrow (q \wedge \quad r)$

c) Using the concepts of Boolean algebra, determine all the values that make the following statements true.

$4 + 3 = 7 \qquad x + 5 = 8$

(i) and **(1 marks)**

$x + 4 = 7 \qquad 4 + 6 = 10$

(ii) and **(1 mark)**

d) Use your knowledge of the truth tables to determine the truth values of the following compound statements.

$2 + 3 = 5 \qquad 1 + 1 = 3$

and **(3 marks)**

Question Four

a) Find the value of x if the matrix A is a singular matrix.

$$A = \begin{pmatrix} 4 & x \\ 2 & 5 \end{pmatrix}$$

(3 marks)

$$A = \begin{pmatrix} -5 & 2 \\ 2 & -2 \end{pmatrix}$$

b) Consider the matrix

Find the:

(i) Eigen values **(3 marks)**

(ii) Eigen vectors **(4 marks)**

c) Find the distance d between the point $P(2,-3,4)$ and the plane $x + 2y + 2z$ **(5 marks)**

d) Show that the statement $(p \vee q) \wedge \quad q \rightarrow p$ is a tautology. **(5 marks)**

Question Five

$$A = \begin{bmatrix} 2.7 & 1.8 \\ 0 & 0.9 \\ 9 & -4.5 \end{bmatrix} \qquad B = \begin{bmatrix} 3 & 5 & -1 \\ 4 & 0 & 2 \\ -6 & -3 & 2 \end{bmatrix}$$

a) If and

Calculate:

(i) $2(A+B)$ **(2 marks)**

(ii) $2A-3B$ **(2 marks)**

(iii) BA **(2 marks)**

b) Find the inverse of the matrix:

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

(7 marks)

c) Use Cramer's rule to solve the simultaneous equation: **(6 marks)**

$$2x+3y=5$$
$$3x-y=2$$

(6 marks)