



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (YR II, SEM II)

SMA 2279: LINEAR AND BOOLEAN ALGEBRA

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: FEBRUARY/MARCH 2012

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- Answer booklet

This paper consists of **FIVE** questions

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

This paper consist of **THREE** printed pages

QUESTION ONE (30 MARKS)

a) Show that $p \rightarrow q$ and $\neg p \vee q$ are logically equivalent (6 marks)

$$A = i - 2j + k \quad B = 4i - 4j + 7k$$

b) Find the projection of the vector on the vector (5 marks)

$$r = 3i + 2j - 5k$$

c) Find the work done in moving an object along a vector if the force applied is

$$F = 2i - j - k$$

(3 marks)

d) Simplify the boolean expression (5 marks)

$$A \cdot \bar{C} + \bar{A} \cdot (B + C) + A \cdot B \cdot (C + \bar{B})$$

$$A = \begin{pmatrix} 3 \\ 2 \\ -4 \end{pmatrix} \quad B = \begin{pmatrix} 5 \\ -1 \\ 3 \end{pmatrix} \quad C = \begin{pmatrix} 6 \\ 7 \\ 8 \end{pmatrix} \quad 2A - C + 2B$$

e) Given that , and . Evaluate (3 marks)

$$\begin{vmatrix} 2 & 3 & 5 \\ -2 & 4 & -1 \\ 6 & -2 & 7 \end{vmatrix}$$

f) Evaluate $\begin{vmatrix} 2 & 3 & 5 \\ -2 & 4 & -1 \\ 6 & -2 & 7 \end{vmatrix}$ by reduction method (4 marks)

g) For what values of a are $A = 2i + aj + k$ and $B = 4i - 2j - 2k$ perpendicular (4 marks)

QUESTION TWO (20 MARKS)

$$X = \begin{pmatrix} 3 & 2 & 2 \\ 1 & 4 & 1 \\ -2 & -4 & -1 \end{pmatrix}$$

$$X^3 - 6X^2 + 11X - 6I = 0$$

a) Show that the matrix X satisfies the equation $X^3 - 6X^2 + 11X - 6I = 0$, where $\mathbf{0}$ is the 3×3 zero matrix and I is the 3×3 identity matrix. (6 marks)

$$(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$$

b) Determine the truth table for $(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$ (6 marks)

c) An automobile travels 3km due north, then 5km northeast. Determine the resultant displacement (6 marks)

d) Classify each of the following as a statement or not a statement
 (i) Jack is tall (1 mark)
 (ii) Nairobi to Mombasa is 510km. (1 mark)

QUESTION THREE (20 MARKS)

$$p \vee \neg(p \wedge q)$$

a) Verify that the proposition $p \vee \neg(p \wedge q)$ is a tautology (5marks)

b) Convert the following numbers to the base shown in brackets
 (i) IBF_{16} (base 10) (3 marks)

(ii) 58.3125_{10} (base 2) (5marks)

c) Derive the Boolean expression and construct the switching circuit (5 marks)

A	B	C	Z
0	0	0	1
0	0	1	0

0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

d) Write the inverse statement to “If I pass English, I will pursue law” (2 marks)

QUESTION FOUR (20 MARKS)

$A = 2i - 3j - k$ $B = i + 4j - 2k$ $(A + B) \times (A - B)$
 a) If _____, find _____ (7 marks)

$$A = \begin{pmatrix} 1 & 3 & 2 \\ 2 & 4 & 2 \\ 1 & 2 & - \end{pmatrix} \quad A^{-1}$$

b) Given that _____, find _____. Hence or otherwise solve the following system.
 $x + 3y + 2z = 3$
 $2x + 4y + 2z = 8$
 $x + 2y - z = 10$

(8 marks)

c) Using De Morgan’s laws simplify the following Boolean expression (5 marks)
 $(\overline{A \bullet B}) + (\overline{A + B})$

QUESTION FIVE (20 MARKS)

a) Evaluate the eigenvectors for each of the eigenvalue in

$$B = \begin{pmatrix} 4 & 2 \\ 3 & -1 \end{pmatrix}$$

(10 marks)

b) Construct a switching circuit for the following Boolean expression

$$A \bullet [A \bullet \overline{B} \bullet C + B \bullet (A + \overline{C})]$$

(5 marks)

c) Find an equation for the plane perpendicular to the vector $A = 2i + 3j + 6k$ and passing through the terminal point of the vector $B = i + 5j + 3k$ (5 marks)

