



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

DIPLOMA IN ELECTRICAL ENGINEERING

EED 306: ELECTROMAGNETISM

DATE: 21/01/2021

TIME: 2.00-4.00 PM

INSTRUCTIONS

Answer Question One and any Other Two Questions

QUESTION ONE (30 MARKS)

- a) i Define a vector
- ii If $\mathbf{a} = \begin{bmatrix} 3 \\ 5 \end{bmatrix}$ and $\mathbf{b} = \begin{bmatrix} 2 \\ 4 \end{bmatrix}$ find
- i) $2\mathbf{a} + 6\mathbf{b}$
- ii) $4\mathbf{a} - 8\mathbf{b}$
- iii) modulus of $2\mathbf{a} - 3\mathbf{b}$ (10 marks)
- b) i Explain the four Maxwell's equations
- ii Vector $\mathbf{OA} = \mathbf{x}$, $\mathbf{OB} = \mathbf{y}$ and $\mathbf{OC} = \mathbf{z}$, find the following
- I. $\mathbf{AB}$
- II. $\mathbf{CB}$
- III. $2\mathbf{BA} - 5\mathbf{BC}$ (10 marks)
- c) i Sarah sold 3 shirts and 2 trousers for Kshs 840/= and 4 shirts and 5 trousers for Kshs 1680/=. Form a matrix equation to represent the above information. Hence find the cost of a shirt and a trouser.

- ii Calculate the energy in a given mass if its frequency is 0.005H. Take planks constant as 6.626×10^{-34} J.s (10 marks)

QUESTION TWO (20 MARKS)

- a) i Differentiate electrodynamics and electromagnetism
 ii Explain what momentum is
 iii Name and explain three characteristics of electromagnetic waves
- iv Given that $\mathbf{A} = \begin{bmatrix} 1 & 3 \\ 5 & 3 \end{bmatrix}$, $\mathbf{B} = \begin{bmatrix} 3 & 1 \\ 5 & -1 \end{bmatrix}$, $\mathbf{C} = \begin{bmatrix} p & 0 \\ 0 & q \end{bmatrix}$ and $\mathbf{AB} = \mathbf{BC}$, determine the value of p. (10 marks)
- b) Vector $\mathbf{OA} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$ and $\mathbf{OB} = \begin{bmatrix} 6 \\ -3 \end{bmatrix}$. Point C is on OB such that $\mathbf{CB} = 2\mathbf{OC}$ and point D is on AB such that $\mathbf{AD} = 3\mathbf{DB}$.
 i) Express $\mathbf{CD}$ as a column vector.
 ii) Find the modulus of $\frac{3}{2}\mathbf{DC}$ (10 marks)

QUESTION THREE (20 MARKS)

- a) Define electrodynamics
- b) Find the values of the following unknowns in each of the following cases
- i) $\begin{bmatrix} 2 & 0 \\ -1 & 1 \end{bmatrix} \begin{matrix} x \\ y \end{matrix} = \begin{bmatrix} 10 \\ 2 \end{bmatrix}$
- ii) $\begin{bmatrix} 4 & 0 \\ 1 & a \end{bmatrix} \begin{bmatrix} b & c \\ -2 & 0 \end{bmatrix} = \begin{bmatrix} 20 & 12 \\ -1 & d \end{bmatrix}$ (10 marks)

QUESTION FOUR (20 MARKS)

- a) i Define flux and give its units.
 ii Explain the four properties of magnetic waves (10 marks)
- b) i Define an electromagnetic wave
 ii Find the matrix product AB and BA where

$$\mathbf{A} = \begin{pmatrix} 1 & 2 & 1 \\ 3 & 0 & 2 \\ 2 & 1 & 3 \end{pmatrix} \text{ and } \mathbf{B} = \begin{pmatrix} -1 & 2 & 0 \\ 1 & -1 & 2 \\ 2 & 3 & -1 \end{pmatrix}$$

Commend on the results.

Given that $\mathbf{X} = \begin{pmatrix} 4 & 3 \\ -1 & 2 \end{pmatrix}$ and $\mathbf{Y} = \begin{pmatrix} 14 & 17 \\ -4 & 2 \end{pmatrix}$ find $\mathbf{Z}$ if $\mathbf{X}^2 + \mathbf{Y} = \mathbf{Z}$ (10 marks)

QUESTION FIVE (20 MARKS)

- a) Define a phase, a photon, wavelength and frequency and give their units
- b) In a triangle OAB, BD: DA=1:2, OE: ED =3:2 and C is the midpoint of OB.
 - i. Draw the triangle OAB and show the positions of points D, C and E.
 - ii. If $\mathbf{OA} = \mathbf{a}$ and $\mathbf{OB} = \mathbf{b}$ express the following vectors in terms of $\mathbf{a}$ and $\mathbf{b}$.
 - I. $\mathbf{AB}$
 - II. $\mathbf{OD}$
 - III. $\mathbf{AE}$