



MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN ELECTRICAL ENGINEERING

ELECTROMAGNETICS

DATE: 10/8/2021
PM

TIME: 2:00 – 4:00

INSTRUCTIONS:

Answer Question One And Any Other Two Questions

1. 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) A Magnetic 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)
2. a) i) Differentiate electrodynamics and electromagnetism
- ii) Explain what momentum is as used in electromagnetics (5 marks)
- b) i) Name and explain three characteristics of electromagnetic waves
- ii) Given that $A \begin{bmatrix} 1 & 3 \\ 5 & 3 \end{bmatrix}$, $B = \begin{bmatrix} 3 & 1 \\ 5 & -1 \end{bmatrix}$, $C = \begin{bmatrix} 1 & 3 \\ 5 & 3 \end{bmatrix}$, $\begin{bmatrix} p & 0 \\ 0 & q \end{bmatrix}$, and $\mathbf{AB} = \mathbf{BC}$ determine the value of p (5 marks)
- c) Vector $\mathbf{OA} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$ and $\mathbf{OB} = \begin{bmatrix} 6 \\ -3 \end{bmatrix}$ point C is on $\mathbf{OB}$ 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 $\frac{3}{5}\mathbf{DC}$ (10 marks)
3. a) i) Define electrodynamics
- ii) Find the values of the following unknowns in each of the following cases
- iii) $\begin{bmatrix} 2 & 0 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 10 \\ 2 \end{bmatrix}$
- iii) $\begin{bmatrix} 4 & 0 \\ 1 & a \end{bmatrix} \begin{bmatrix} b & c \\ -2 & 0 \end{bmatrix} = \begin{bmatrix} 20 & 12 \\ -1 & d \end{bmatrix}$ (10 marks)

b) i) Define an electromagnetic wave

ii) Find the magnetic matrix product $\mathbf{AB}$ and $\mathbf{BA}$ where

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

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

(10 marks)

4. a) Define a phase, a photon, wavelength and frequency and give their Units. (8 marks)

b) In a triangular magnetic vector configuration, $\mathbf{OAB}$, $\text{BD}:\text{DA}=1:2$, $\text{OE}:\text{ED}=3:2$ and C is the midpoint of OB .

i) Draw the magnetic triangle $\mathbf{OAB}$ 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) $\mathbf{AE}$

(12 marks)