



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

..... YEAR..... SEMESTER EXAMINATION FOR BACHELOR

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EET 421 – ELECTROMAGNETICS

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

- a. ..
- i. Briefly explain how field (magnetic or electric) phenomenon manifest itself in nature. (2marks)
 - ii. Compare Coulomb's Law with Newton's Law of Gravity. (2marks)
- b. With the help of neat sketches, differentiate:-
- i. The curl of a Vector from divergence of a Vector. (1.5marks)
 - ii. Monopole from a dipole. (1.5marks)
 - iii. Dielectric permittivity from permeability of a material. (1.5marks)
- c. Given Vector $\vec{X}, \vec{Y}, \vec{z}$, Determine:-
- i. $\vec{X} \times \vec{y}$ (2marks)
 - ii. $\vec{X} \cdot \vec{y}$ (2marks)
 - iii. $(\vec{X} \times \vec{y}) \cdot \vec{z}$ (2marks)
- d. .
- i. With the help of diagram, briefly explain image theory. (3marks)
 - ii. State Maxwell's equations in integral form. (2marks)
- e. .
- i. Differentiate transverse electric (TE) polarization from Transverse Magnetic TM polarization. (3marks)
 - ii. For a dielectric material, which components are:- tangential and which are normal to a boundary. (2marks)
- f. Given Vector \vec{x} from origin is (2, 3, 2) and Vector Y from tip of Vector \vec{x} is (4, 5, 4)
Find:
- i. Vector \vec{x} and its magnitude (2marks)
 - ii. The angle between \vec{x} and y-axis (2marks)
 - iii. Vector \vec{y} and its magnitude. (2marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

- a. What is a conservative field? (2marks)
- b. Two metal spheres with charges of -72mC and +32mC are brought together into contact with each other for a short time. After separation, one of the metal spheres has a charge of -24mC.
 - i. What is the electric charge of the other metal? (4marks)

- ii. How much electric charge was transferred (3marks)
- iii. And where was it transferred from? (1.5marks)
- iv. What are the change carriers? (1mark)
- c. Given two complex numbers,
 $A = 4-3j$ and $B = -3-2j$
 - i. Express A and B in Polar Form, find:
 - ii. AB (2marks)
 - iii. $\frac{A}{B}$ (2marks)
 - iv. AB^* (2marks)

QUESTION THREE (20 MARKS)

- a. State Ampere's Law. (2marks)
- b.
 - i. Determine the magnetic field H, at point (0,0,5), for a semi circular section of current- curveying wire, as shown in fig. Q3b.
 - ii. What will be the value of H at point (0,0,0) (2marks)
 - iii. How do you conclude the value of H at (0,0,5) and at (0,0,0)

Insert diagram.....

- c. Ud Plane wave propagating in a lossless medium has an electric field, $E_x = E_0 \cos(1.6 \times 10^{10}t - 59, 4Z)$. Determine:-
 - i. Wove velocity, c_0 (2marks)
 - ii. Wavelength, (2marks)
 - iii. Wave impedence for the wave. (2marks)
 - iv. Dielectric constant. (2marks)

QUESTION FOUR (20 MARKS)

- a. State Biot – Sarvat's Law (2marks)
- b. Express Biot – Sarvat's Law in terms of distributed current sources:-
 - i. Line currents (2marks)
 - ii. Surface currents (2marks)
 - iii. Volume currents (2marks)
- c. The Fig. Q4C, below show 3 planer dielectric slabs of equal thickness, but with dielectric constants as indicated. If E_0 in air makes an angle of 45° with respect to the Z- axis, find
 - i. The angle of E in each layer of the slab. (6marks)

ii. How do you ... the angle with permittivity of the medium.
Insert diagram.....

d. State Maxwell's time varying equation in integral form. (4marks)