THE MOMBASA POLYTECHNIC UNIVERSITY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING.

FACULTY OF ENGINEERING AND TECHNOLOGY

SECOND YEAR / SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF

BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONIC ENGINEERING

EEE 2215 ELECTROMAGNETICS I

SEPTEMBER 2010 SERIES TIME: 2 HOURS

INSTRUCTION TO CANDIDATES

Answer question ONE and any other TWO questions.

Q4 1. (a) A surface charge distribution is contained in a flat, wedge shaped surface whose corners are defined in a rectangular coordinate system by (2, 1, 2)M, (1, 1, 2)M and (1, 3, 2)M. The charge distribution is given by

$$\rho_S = 3xyz \ C/m^2$$

Determine the total charge on the surface
(10 MARKS)

(b) A cylindrical volume : $0 \leq z \leq 4m$, $0 \leq r \leq 2$, encloses charge. If the electric field is

$$\bar{E} = 2r/\varepsilon_0 \ a_z$$

determine the total charge enclosed by the cylinder
(9 MARKS)

(c) A toroid is constructed of a ring of highly permeable material as shown in figure Q4.(1c). The inner radius of the toroid is a and the outer radius is b and there are N turns wound on it. The windings are tightly wound so that all flux remains in the toroid. Determine an expression for the magnetic field intensity vector for

(i) $r < a$
(ii) $a < r < b$
(iii) $r > b$

Hint: Use Ampere's law and integrate around

· a circle of radius r.

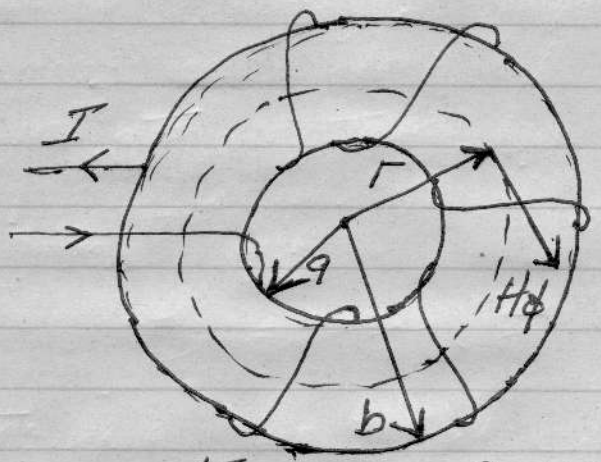



Figure: Q1(1c) (7 MARKS)

1(d) With the aid of sketches illustrate the principle of shielding against static electric fields (electrostatic shielding). (4 MARKS)

2 (a) Describe the following electromagnetic quantities

(i) Electric field intensity vector $\bar{E}$

(ii) Electric flux density vector $\bar{D}$

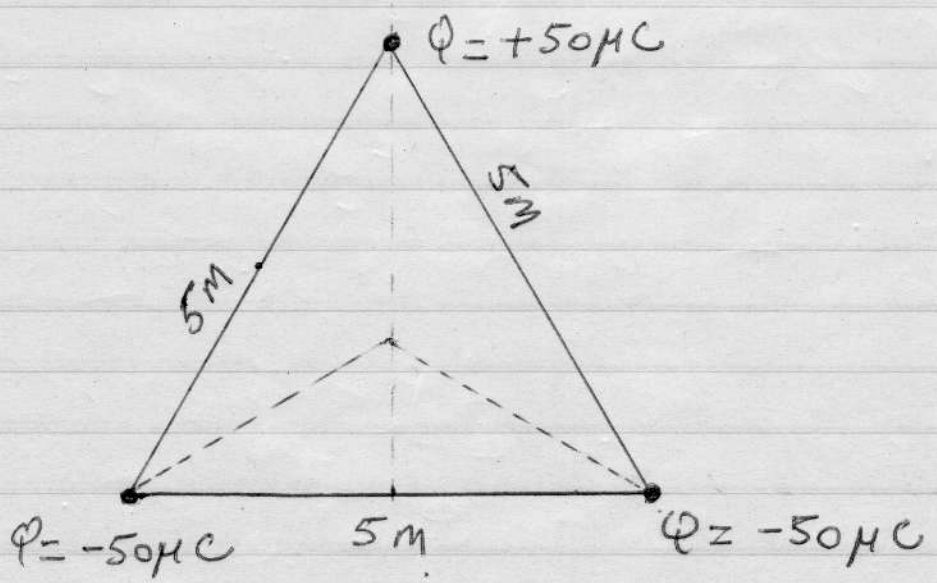
(iii) Magnetic field intensity vector $\bar{H}$

(iv) Magnetic flux density vector $\bar{B}$

(4 Marks)

(b) Two point charges $Q_1 = 18\mu C$ and $Q_2 = 72\mu C$ are separated by 3cm. A third charge $Q_3 = -8\mu C$ is introduced between the other two. Determine the distance between $Q_1$ and $Q_3$ such that $Q_3$ will not move. (7 Marks)

(c) A positive $50\mu C$ point charge and two negative $50\mu C$ charges are placed on the corners of an equilateral triangle whose sides are of length 5m. Determine the magnitude of the electric field intensity at the centre of the triangle. (9 Marks)



and explain

3 (a) (i) Define Gauss' law

(ii) A spherical volume charge distribution $\rho_v = kr\ C/m^3$ is contained in a spherical volume of radius a and the medium is free space. Determine:

I The total charge enclosed by the volume

II The electric field intensity for $r \gg a$

(12 Marks)

(b) Can Gauss' law be used to determine the electric field at a distance d from the centre and on a line perpendicular to:

(i) A ring

(ii) A disk ?

(8 MARKS)

4 Two infinitely long current filaments are parallel and separated a distance d. If the currents of the filament are I but are oppositely directed, determine the magnetic field intensity vector:

(a) Midway between the currents

(b) At a distance $\Delta$ from the center and in the plane containing the current (Hint: investigate for $\Delta > d/2$ and $\Delta < d/2$) where d is the distance between the two wires.

(c) Figure (Q4 4C) shows a straight wire of radius a and carries a current $I_1$ along the axes of a metal tube with inner radius b and outer radius c. The tube carries a current $I_1$ in a direction opposite to that in the wire. Find H for:

(i) $a < r < b$

(ii) $r > c$

(8 MARKS)

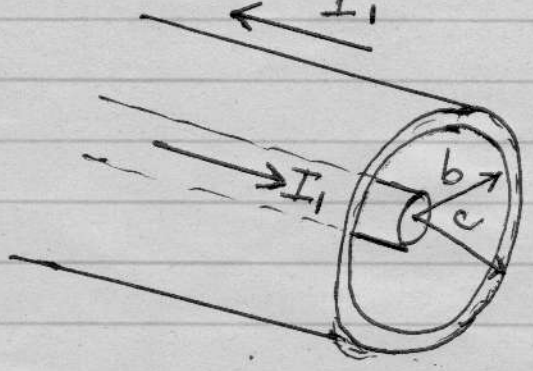



Fig (Q4(4c)

5(a) Determine the per-unit length inductance of a coaxial cable having an inner conductor of radius a and an inner radius of the outer conductor b (10 MARKS)

(b) With appropriate examples illustrate how the following effects can upset the operation of electronic devices

(i) Electrostatic discharge (ESD)

(ii) Interference

(iii) Parasitics (10 MARKS)