KENYA METHODIST UNIVERSITY
END OF FIRST TRIMESTER 2007 EXAMINATIONS

FACULTY : SCIENCES
DEPARTMENT : MATHEMATICS AND COMPUTER SCIENCE
COURSE CODE : PHYS 200
COURSE TITLE : PHYSICS 1I
TIME : 3 HRS

Instructions:
- Answer any three questions
- You may use the following information where applicable.

The following constants may be useful.

i) Permitivity of free space $\sum$ = 8.85 x 10^{4} TM

ii) Permeability of free space M = 40 x 10^{-7} TMA^{+}

iii) BIOT – Savart constant RM = 10^{-7} TMA^{-1}

iv) Coulomb force constant Ka = 8.99 x 10^{9} al M^2C^{-2}

v) Resistivity of aluminium = 1.824 x 10^{-8} Ω m

vi) Resistivity of Nichrome = 1.00 x 10-8 Ω m

vii) Refractive index of air = 1.00

viii) Refractive index of water = 1.33

Question 1

a) What is current density? (2 mks)

b) In a plasma having a circular cross-section with radius 5cm, the current density varies with the radial distance form the axis of the direction of current according to the relationship J = 100rk A/m^2. Determine the total current of the plasma. (8 mks)

c) State Faraday's Law of electromagnetic induction and give its representation in equation form. (4 mks)

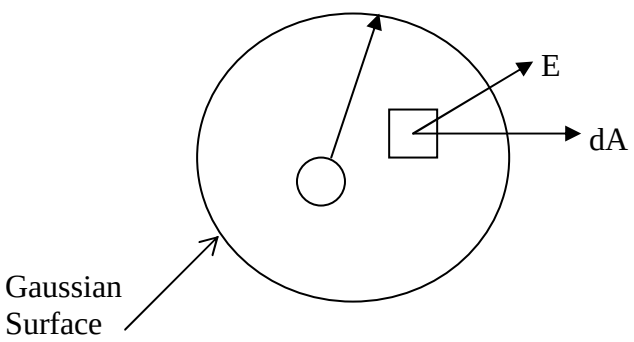
d) The current in a coil of wire is charged uniformly according to the relationship I = 0.10 tA, where t is the time in seconds. An induced e.m.f of 0.13 MV is in addition to any Pd across the leads that is due to the resistance of a coil. What is the self inductance of the coil? (7 mks)

e) A coil is wrapped with 200 turns of wire on the perimeter of a square frame of sides 18 cm. Each turn has the same area equal to that to the frame and the total resistance of the coil is 200 Ω. A uniform magnetic field is turned on perpendicular to the plane of the coil. If the field changes linearly from 0 to 0.5 wb/m^2 in a time of 0.08s, find the magnitude of the induced e.m.f in the coil while the field is changing. (7 mks)

Question 2

a) State Gauss law and give its mathematical statement. (3 mks)

b) Starting with Gauss's law, calculate the electric field due to an isolated point charge q and show that coulomb's law follows from this result. The following diagram is useful. (8 mks)



c) A point charge of 5uC is placed at the centre of a spherical shell of radius 15 cm. Calculate the total electric flu through the following:

i) The entire surface of the shell i.e. at r = 15cm (17 mks)

ii) Any hemispherical surface of the shell. (3 mks)
iii) Do the results depend on the radius? Explain. (2 mks)

Question 3

a) i) Write down the mirror equation of spherical mirrors. (2 mks)
ii) An object of height 2.5 cm is placed infront of a concave mirror whose radius of curvature is 20 cm. Determine:
a) The position of the mirror. (4 mks)
b) The magnification and size of the image. (4 mks)

b) Derive the Len's makers formula shown below for a biconvex lens.

$$\frac{1}{f} = (n-1)\left(\frac{1}{R} - \frac{1}{R_2}\right)$$

Where $\frac{1}{s} + \frac{1}{s^1} = \frac{1}{f}$ (13 mks)

Question 4

a) Distinguish between inductive reactance and capacitive reactance in A.C circuits. (5 mks)
b) A series RCL circuit consists of a resistance of $250\,\Omega$, an inductor of 0.1H and a condenser (capacitor) of 50mf. The applied voltage has a frequency of 600 Hz. Does the current lead or lag behind the applied voltage and by what angle?
c) i) Give a statement of Biot-Savarts law. (3 mks)
ii) Two parallel wires carry currents of 10A and are separated by 1mm distance. What is the force on a 2m long portion of the wires? (5 mks)
iii) Give three differences between electric and magnetic forces. (3 mks)