



EMBU UNIVERSITY COLLEGE

(A Constituent College of the University of Nairobi)

2015/2016 ACADEMIC YEAR

SECOND SEMESTER EXAMINATION

FIRST YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SPH 102: ELECTRICITY AND MAGNETISM I

DATE: APRIL 7, 2016

TIME: 08:30-10:30AM

INSTRUCTIONS:

Answer Question ONE and ANY Other TWO Questions

Constants: $\mu_0 = 4\pi \times 10^{-7}$

$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2/\text{Nm}^2$

QUESTION ONE

- A cylindrical conductor of radius $x = 2\text{cm}$ has conductivity of $2.0 \times 10^5 \text{ A/m}^2$. Determine the current through the outer portion of the conductor between radial distances $x/4$ and x .
(4 Marks)
- What is charge?
(1 Mark)
- The resistance of a platinum wire at 0°C is 4Ω . What will be the resistance of the wire at 100°C , if the temperature coefficient of platinum is $0.0038^\circ \text{C}^{-1}$?
(3 Marks)
- A vertical rectangular coil of sides 5 cm by 2 cm has 10 turns and carries a current of 2 A . Calculate the torque on the coil when it is placed in a uniform horizontal field of 0.1 T with its plane parallel to the field.
(4 Marks)
- Show that the amount of work in bringing a charge dq from one plate of a parallel plate capacitor to the other one is given by :
(3 Marks)

$$W = \frac{1}{2} CV^2$$

- f) The length of a conductor is 41 cm and it has a cross sectional area of 7 cm². If it is an air cored solenoid with 500 turns, find its self-inductance. (3 Marks)
- g) The resistance of a copper wire 200 m is 21 Ω. If its thickness is 0.044 cm, calculate the specific resistance. (4 Marks)
- h) A galvanometer of resistance 500 Ω can measure currents up to 2 mA. Find the resistance of a resistor if a current of 3 A is to be measured with it. (3 Marks)
- i) A pair of conductors each is carrying a current of 10 A and they are at a distance of 10 cm apart. Find the magnitude and the direction of the force per 110 cm length of conductors. (3 Marks)
- j) A solenoid of length 20 cm and radius 2 cm is closely wound with 200 turns. Calculate the magnetic field intensity at the center of the solenoid. The current in the solenoid being 5A.

QUESTION TWO

- a) Two similar balls of mass, m, are suspended from a silk thread of length, l, and carry similar charges. Prove that the separation distance ,x , is given by

$$x = \left(\frac{q^2 l}{2\pi\epsilon_0 m g} \right)^{\frac{1}{3}} \quad \text{when } \theta \text{ is small} \quad (6 \text{ Marks})$$

- b) A linear wire AB is carrying a current I. determine the magnetic field intensity at a point, p, which is at a distance, d, from the conductor center. Assume that the diameter of the wire is negligible. (12 Marks)

QUESTION THREE

- a) An alpha particle travels in a circular path of radius 0.5 m in a magnetic field of B = 1.2 W/m². Find:
- i) Its speed (4 Marks)
- ii) Time period of the revolution (4 Marks)
- iii) Its kinetic energy (3 Marks)

- b) A parallel plate capacitor consists of two plates of 2 m by 1 m with a space between the plates of 1 mm and is filled with dielectric of relative permeability of 7.0. A potential difference of 300 v is applied across the plate. Find;
- i) The capacitance (3 Marks)
 - ii) Charge on the capacitor (2 Marks)
 - iii) Electric flux density (2 Marks)
 - iv) Potential gradient (2 Marks)

QUESTION FOUR

- a) A copper rod of length x y is moving with a velocity of 5 m/s parallel to a long straight wire carrying a current of 10A. Calculate the induced emf in the rod if its lower end A is 18 cm away from the wire and its upper end is 2 cm away from the wire. (10 Marks)
- b) Three charges of $1/3 \times 10^{-9}$ C, $8/3 \times 10^{-9}$ c and $10/3 \times 10^{-9}$ C are placed at three corners of an equilateral triangle of side 20 cm. find the resultant force on the charge of $10/3 \times 10^{-9}$ C. (10 Marks)

QUESTION FIVE

- a) A transformer on a utility pole operates at $V_p = 8.5$ kV on the primary side and supplies electrical energy to a number of nearby houses at $V_s = 120$ V. Assuming an ideal step down transformer, a purely resistive load and a power factor of unity:
- i) Find the turns ratio (4 Marks)
 - ii) If the average rate of energy consumption in the houses is 78 kW, find the rms current in primary and secondary coils of the transformer (6 Marks)
 - iii) Find the resistive load R in the secondary circuit and the corresponding resistive load in the primary circuit. (4 Marks)
- b) A copper wire is stretched such that it becomes 0.1% longer. Find its percentage change in its resistance. (6 Marks)

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