

5. (a) Use Gauss's theorem to calculate the electric field due to infinite line charge distribution. (9)
- (b) Derive the expression $P = \epsilon_0 E \{K - 1\}$. where symbols have their usual meaning. (3)
- (c) Derive an expression of generalized form of Gauss's law for a polarized dielectric. (6)
6. (a) A semi-circular loop of radius a lying in xy plane carrying a current I in counterclockwise direction and is placed in a uniform magnetic field B pointing in the y direction. Calculate the net magnetic force acting on the semicircular loop. (3)
- (b) State and explain Biot-Savart's law. Derive the expression of magnetic field due to finite long wire at a point perpendicular to it. (9)
- (c) A circular coil of radius 10 cm having 50 turns carries a current. The center of the coil is the position of a null point. What is the magnetic field due to coil at an axial point at a distance 20 cm from the center of the coil. (6)

Constants:

$$\mu_0 = 4\pi \times 10^{-7} \text{ henry/metre (free space)}$$

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N.m}^2 \text{ (free space)}$$

(1000)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 6091

H

Unique Paper Code : 2224001201

Name of the Paper : Electricity and Magnetism

Name of the Course : B.Sc. Hons. – GE

Semester : II

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

- Write your Roll No. on the top immediately on receipt of this question paper.
- Answer **five** questions in all.
- Question No. 1 is compulsory
- All** questions carry equal marks.
- Use of Simple Calculator allowed.

- Attempt **All** of the following : (6×3)

(a) State the superposition theorem for linear network. What is its application?

(b) Write Poisson's and Laplace equations. What are their importance?

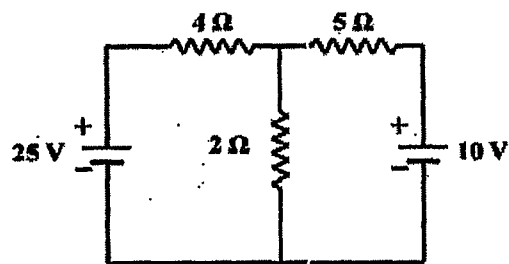
P.T.O.

6091

2

- (c) Two parallel plates each of area 1 m^2 are at perpendicular distance of 0.1 m apart. The plates have equal and opposite charge on their surface. The electric field between the plates is 100 N/C . What is the charge on each plate?
- (d) At the boundary of two dielectric of different dielectric constant, show that the normal components of displacement field are equal. Assume that there are no free charges on the surface of the two dielectrics.
- (e) A horizontal overhead power line carries a DC of 90 A going from east to west direction. What is the magnitude and direction of magnetic field at a distance 1.5 m perpendicular to the line below it?
- (f) Is the Ampere's law equally valid for AC as it is applicable for DC? Why?

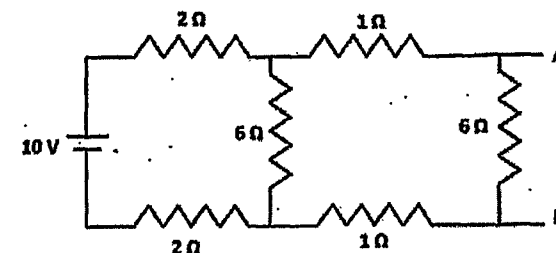
2. (a) Find the current through 2Ω resistor using superposition theorem. (3)



6091

3

- (b) Give statements of Thevenin & Maximum power transfer theorems. Explain them with examples. (9)
- (c) Determine the Thevenin equivalent circuit across AB for the following circuit: (6)



3. (a) State and prove Stoke's theorem. How is it significant? (12)
- (b) Suppose S is any closed surface enclosing a volume V and $\mathbf{A} = (ax)\mathbf{i} + (by)\mathbf{j} + (cz)\mathbf{k}$. Prove that.
- $$\oint_S \mathbf{A} \cdot \hat{n} \, ds = (a + b + c) V. \quad (6)$$
4. (a) State and prove Gauss's law of electrostatics and derive its differential form. (12)
- (b) Show that the force between two charges separated by a distance, is reduced by a factor
- $$\left[\frac{1}{1 + \frac{P}{(\epsilon_0 E)}} \right] \text{ due to the presence of a dielectric medium having dielectric constant } \epsilon_r. \quad (6)$$

P.T.O.