This question paper contains 4 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **937**

Unique Paper Code : **222203** **E**

Name of the Paper : **Electricity and Magnetism (PHHT-205)**

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : **II**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *Five* questions in all.

Question No. **1** is compulsory.

All questions carry equal marks.

Non-programmable calculators allowed.

1. Attempt any *five* of the following questions : 5×3=15

(*a*) Show that the line integral of electric field is independent of the path.

(*b*) Determine whether the electric field produced by the potential $V = 50x^2 - 75y$ in a given region of space is uniform or not.

(*c*) Define equipotential surfaces. Can two equipotential surfaces intersect ?

(*d*) The magnetic flux through a circular loop varies with time t as $0.033\ t^3$ Weber. Calculate the induced emf in the loop at $t = 1$ millisecond.

P.T.O.

(*e*) For a magnetic circuit, explain the terms magneto-motive force and reluctance.

(*f*) Draw hysteresis curve for materials suitable for use (*i*) in a transformer, (*ii*) as a permanent magnet.

(*g*) The successive deflections to the right and left of the mean position in the case of ballistic galvanometer and found to be 25.0, 24.9 and 24.8 cm respectively. Calculate the logarithmic decrement.

2. (*a*) Show that the capacitance of a spherical conductor of radius a enclosed by an earthed concentric spherical shell of radius b is given by :

$$C = 4\pi \epsilon_0 \frac{ab}{b-a}.$$

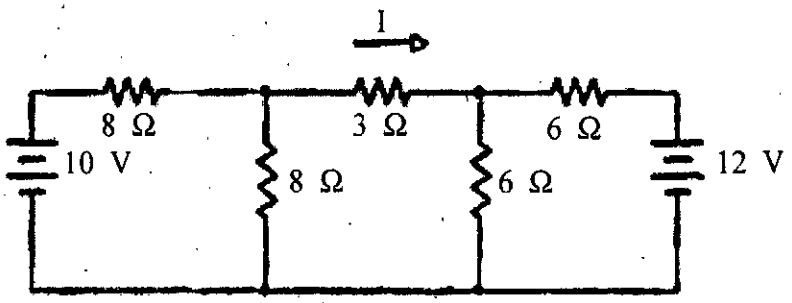
(*b*) A point charge q is placed in front of an earthed conducting shpere of radius R at a distance d from its center. Determine using the method of images, the electric potential at a point outside the sphere. 5,10

3. (*a*) State Gauss's law in electrostatics. Deduce its differential form.

(*b*) Derive an expression for potential and electric field at a point (r, θ) due to an electric dipole. 5,10

4. (*a*) State and prove Thevenin's theorem.

(*b*) Determine the current I in the given circuit using Thevenin's theorem.



(*c*) A capacitor of 250 pF is connected in parallel with a coil having inductance 0.16 mH and resistance 20Ω. Calculate the :

(*i*) resonance frequency and

(*ii*) circuit impedance at resonance. 7,4,4

5. (*a*) State Biot-Savart's law. Derive an expression for the magnetic field at a point due an infinitely long straight current carrying conductor using Biot-Savart's law.

(*b*) Define magnetic susceptibility and permeability. Establish a relation between them.

(*c*) A circular coil of 100 turns has an effective radius 50 cm and carries a current 0.10 amp. Calculate the amount of work required to turn the coil in an external uniform magnetic field 1.5 Weber/m^2 through an angle of 180°. 8,4,3

6. (*a*) Define magnetic vector potential. Derive an expression for the magnetic vector potential due to a current loop of an area *a* carrying uniform current I.

P.T.O.

(*b*) Prove that the energy stored in a magnetic field is given by :

$$\frac{1}{2}\int \text{H.B } d\tau$$

where volume integral is taken over all space. 7,8

7. (*a*) Differentiate between dead beat and ballistic galvanometer.

(*b*) A capacitor charged to 2 volts is discharged through a ballistic galvanometer. Calculate the capacitance if the corrected deflection is 9.6 cm and the time period is 12 sec. The current sensitivity of the B.G. is 4.54×10^2 mm/μA.

(*c*) Two inductances L_1 and L_2 are connected in parallel. If M is the mutual inductance between them, show that their effective inductance, L_{eff}, is given by : 3,5,7

$$L_{eff} = \frac{L_1L_2 - M^2}{L_1 + L_2 \pm 2M}$$