is question paper contains **4** printed pages]

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

No. of Question Paper : **1560**

ique Paper Code : **222463** **C**

me of the Paper : **Physics-IV (Electricity, Magnetism and Electromagnetic Theory) (PHPT-404)**

ne of the Course : **B.Sc. (Prog.)**

nester : **IV**

ation : **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.

Use of non-programmable scientific calculator is allowed.

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

(*a*) The electrostatic potential at any point is given by :

$$V = x^2y + 2z.$$

Find the magnitude of electrostatic field at a point (2, 1, 1).

(*b*) Using Biot-Savart's law, prove that $\vec{B}$ is a solenoidal vector.

(*c*) What is Lenz's Law of electromagnetic induction ? Show that it is in accordance with the law of conservation of energy.

(*d*) Define electrostatic potential and establish the relation $\vec{E} = -\vec{\nabla} V$ .

P.T.O.

(*e*) What do you understand by polarisation of electromagnetic waves ? Discuss circular polarisation of electromagnetic waves.

(*f*) Deduce Brewster's law on the basis of electromagnetic theory.

(*g*) What is displacement current ? Justify its necessity and find an expression for it.

(*h*) Prove that $M_{max} = (L_1 L_2)^{1/2}$, where the symbols have the usual meanings.

(*a*) State and prove Gauss' law in electrostatics. 6

(*b*) Using Gauss's law, calculate electric field at any point due to a uniformly charged infinite sheet. 4

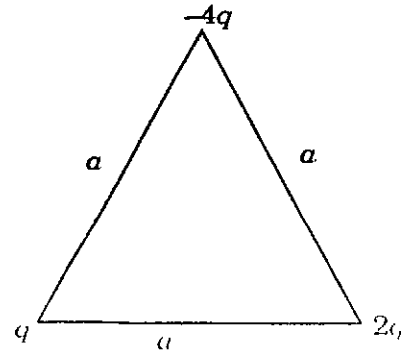
(*c*) Two large metal plates of area 1.0 $m^2$ facing each other are separated by 5 cm carrying equal and opposite charges on their inner surfaces. If $\vec{E}$ between the plates is 55 N/C, find the charge on the plates. 5

(*a*) What is dipole moment ? Obtain an expression for the potential due to an electric dipole at a point on its :

(*i*) axis

(*ii*) perpendicular bisector. 10

(*b*) Three charges are arranged as shown in figure, calculate their mutual potential energy when $q = 1.0 \times 10^{-7}$ C; $a = 10$ cm and discuss the result. 5



*a*) State Biot-Savart's law and find an expression for the intensity of the magnetic field at a point on the axis of a circular coil carrying current. 10

*b*) Two similar coils of wire having a radius of 7 cm and 60 turns have a common axis and are 18 cm apart. Find the strength of the magnetic field at a point midway between them on their common axis, when a current of 0.1 A is passed through them. 5

*a*) Define current sensitivity and charge sensitivity of Ballistic Galvanometer. Establish the relationship between them. 6

*b*) What is electromagnetic damping in galvanometer ? How is it reduced in Ballistic Galvanometer ? 4

*c*) Derive an expression for logarithmic decrement of a Ballistic Galvanometer. 5

*a*) State Faraday's laws for electromagnetic induction. 5

*b*) What is the self-inductance of the coil ? Show that the energy expended in establishing a current (I) in a coil of self-inductance (L) is $\frac{1}{2}LI^2$. 5

*c*) Derive the boundary conditions satisfied by the electromagnetic field vectors $\vec{E}$ and $\vec{H}$ on the plane interface between two dielectric media. 5

*a*) Write differential and integral forms of Maxwell's equations for electromagnetic field and explain their physical significance. 8

(*b*) Write Maxwell's equations for a linear, homogeneous and isotropic dielectric medium. Derive electromagnetic equations and find the velocity of these waves in the medium. 7

8. (*a*) Discuss Maxwell's modification of Ampere's Law. 6

(*b*) Obtain Fresnel's relations for reflection and refraction of plane electromagnetic wave incident normally at a plane interface separating the two dielectric media. 9

**Physical Constants** :

$$\varepsilon_0 = 8.854 \times 10^{-12} \text{ C}^2/\text{N-m}^2;$$

$$e = 1.6 \times 10^{-19} \text{ C};$$

$$\mu_0 = 4 \times 10^{-7} \text{ Wb/A-m};$$

$$c = 3 \times 10^8 \text{ m/s}.$$