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63 (FY)SEM-2/MIN2/PHYMIN1024

2024

**PHYSICS**

Paper : PHYMIN1024

***(Electricity, Magnetism and  
Electromagnetic Theory)***

Full Marks : 50

Pass Marks : 20

Time : Two hours

***The figures in the margin indicate  
full marks for the questions.***

1. Choose the correct answer : 1×5=5

(a) If  $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$ , then angle between  $\vec{A}$  and  $\vec{B}$  is

(i)  $0^\circ$

(ii)  $30^\circ$

(iii)  $60^\circ$

(iv)  $90^\circ$

Contd.

(b) Which of the following relation represents Biot-Savart's law ?

(i)  $\overline{dB} = \frac{\mu_0}{4\pi} \frac{\overline{dl} \times \overline{r}}{r}$

(ii)  $\overline{dB} = \frac{\mu_0}{4\pi} \frac{\overline{dl} \times \overline{r}}{r^3}$

(iii)  $\overline{dB} = \frac{\mu_0}{4\pi} \frac{\overline{dl} \times \overline{r}}{r^3}$

(iv)  $\overline{dB} = \frac{\mu_0}{4\pi} \frac{\overline{dl} \times \overline{r}}{r^4}$

(c) Which of the following represents 1MeV?

(i)  $1.6 \times 10^{-6} \text{ erg}$

(ii)  $1.6 \times 10^{-12} \text{ erg}$

(iii)  $1.6 \times 10^{-6} \text{ J}$

(iv)  $1.6 \times 10^{-12} \text{ J}$

(d) "The emf developed in a circuit opposes the cause to which it is due." This is

(i) Lambert's law

(ii) Faraday's law

(iii) Lenz's law

(iv) Neumann's law

(e) The S.I. units of displacement current is

(i) H

(ii) A

(iii)  $\text{Fm}^{-1}$

(iv) C

2. Answer the following questions : **(any five)**  
2×5=10

(a) Prove that  $\overline{B} = \text{curl } \overline{A}$

Or

$$\overline{B} = \overline{\nabla} \times \overline{A}$$

(b) What do you mean by magnetic vector potential ?

(c) Show that  $\overline{\nabla} \times \overline{E} = 0$

(d) Deduce the integral form of Faraday's law.

(e) Show that  $\frac{\partial \rho}{\partial t} + \overline{\nabla} \cdot \overline{J} = 0$

where  $\rho$  is the charge density and  $\overline{J}$  is the current density.

(f) Show that Lenz's law follows the principle of conservation of energy.

- (g) Define magnetic permeability and susceptibility.
3. Write short notes on : **(any five)**  $5 \times 5 = 25$
- (a) Gauss's divergence theorem
  - (b) Dia, Para and Ferro-magnetic materials
  - (c) Parallel, Spherical and Cylindrical capacitors
  - (d) Energy stored in magnetic field
  - (e) Polarization of electromagnetic wave
  - (f) Maxwell's equation
  - (g) Displacement current
  - (h) Magnetic energy density
4. Answer the following questions : **(any one)**  
 $10 \times 1 = 10$
- (a) State and prove Gauss's theorem in electrostatics, both for the charges situated inside and outside the surface.  
 $2 + 4 + 4 = 10$
  - (b) Define Poynting vector. Show that Poynting vector measures the flow of energy per unit area per second in an EM wave.  
 $2 + 8 = 10$
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