2022

Time : 3 hours

Full Marks : 75

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Answer from both the Groups as directed.

Group – A
(Compulsory)

1. Answer all questions of the following : 1×10 = 10

   (a) Define cross product of two vectors.

   (b) State Gauss divergence theorem.

   (c) Write the S. I. unit of electric flux.

   (d) Write the dimensional formula of energy density.

(e) Give the mathematical relation between electric field and electric potential.

(f) What is Ampere's circuital law ?

(g) Give an example of ferromagnetic material.

(h) Give the speed of light in air.

(i) Write the significance of Lenz's Law.

(j) What is the characteristic of a plane polarised light ?

2. Derive the expression of electric potential due to a point charge. 5

Group – B

(Descriptive Type Questions)

Answer any **four** questions of the following : 15×4 = 60

3. If vector $\vec{A} = x_1\hat{i} + y_1\hat{j}$

and $\vec{B} = x_2\hat{i} + y_2\hat{j}$

(a) Find the expression for the angle between $\vec{A}$ and $\vec{B}$.

(b) Find a vector that is perpendicular to both vectors $\vec{A}$ and $\vec{B}$.

(c) Find the component of $\vec{A}$ along the direction of $\vec{B}$.

4. Use Gauss's theorem to :

(a) Calculate electric field (E) due to a point charge q at a distance r from it.

(b) Show that electric field inside a charged hollow metallic sphere is zero.

(c) Calculate electric field (E) near a uniformly charged plane sheet with charge density σ.

5. (a) Define electric dipole.

(b) Find the electric potential due to an electric dipole moment at its centre.

(c) Find torque on a dipole moment $\vec{P}$ placed in an uniform electric field $\vec{E}$.

6. Explain the characteristics of the following magnetic materials with an example of each type of material :

(a) Paramagnetic material

(b) Diamagnetic material

(c) Ferromagnetic material

7. (a) Explain Faraday's law of electromagnetic induction.

(b) Find the expression of magnetic energy stored in a solenoid.

(c) Give the direction of the induced current in a coil when a bar magnet is quickly passed through the center of the coil along its axis from one side to another.

8. (a) What is displacement current ?

(b) Derive the expression for displacement current between the plates of a parallel plate capacitor.