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63 (FY)SEM-2/MIN2/PHYMIN1024

2025

PHYSICS

(MINOR)

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 option from the following :

1×5=5

(a) The electric displacement vector \vec{D} is give by

(i) $\vec{E} + \vec{P}$

(ii) $\epsilon_0 \vec{E} + \vec{P}$

(iii) $\frac{\vec{E}}{\vec{P}}$

(iv) $\epsilon_0(\vec{E} + \vec{P})$

(b) The relation between magnetic field (\vec{B}) and magnetic vector potential (\vec{A}) is

(i) $\vec{B} = \nabla \cdot \vec{A}$

(ii) $\vec{B} = \frac{\partial \vec{A}}{\partial t}$

(iii) $\vec{B} = \nabla \times \vec{A}$

(iv) $\vec{B} = \nabla^2 \vec{A}$

(c) $\nabla \cdot \nabla \times \vec{A}$ is

(i) a scalar

(ii) a vector

(iii) zero

(iv) $\nabla^2 \vec{A}$

(d) Which of the following is the unit of magnetic flux density?

(i) weber/metre²

(ii) tesla

(iii) newton/ampere-metre

(iv) weber

(e) The potential energy of a dipole placed in an electric field is

(i) $\vec{p} \times \vec{E}$

(ii) $-\vec{p} \times \vec{E}$

(iii) $\vec{p} \cdot \vec{E}$

(iv) $-\vec{p} \cdot \vec{E}$

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

(a) Show that $\vec{E} = -\nabla V$, where \vec{E} and V represent electric field and potential respectively.

(b) State the Gauss's divergence theorem of vectors and give its mathematical expression.

(c) If $\phi = 3x^2y - y^2z^2$, find $\nabla \phi$ at the point (1, 2, -1).

(d) Define magnetic permeability and magnetic susceptibility.

(e) Calculate the capacitance of earth.
(Radius of earth = 6400 km)

(f) Define vector triple product.

(g) Define Poynting vector. What is its unit?
1+1=2

3. Answer the following questions : **(any five)**
5×5=15

(a) Obtain Gauss's theorem in dielectrics.

(b) Using Ampere's circuital law, find the expression for the magnetic field due to current carrying long straight conductor.

(c) Write down Maxwell's equations of electromagnetic wave. Which equation implies the non-existence of magnetic monopole?
4+1=5

(d) Derive an expression for mutual inductance of two coils.

(e) State Biot-Savart's law and using this law find the magnetic field at the centre of a current carrying circular coil.
1+4=5

(f) Using Gauss's theorem, calculate the electric field outside and inside of a uniformly charged solid sphere of radius R .

(g) If $\vec{A} = x^2z^2\hat{i} - 2y^2z^2\hat{j} + xy^2z\hat{k}$, find $\nabla \cdot \vec{A}$
and $\nabla \times \vec{A}$.
2+3=5

(h) State Lenz's law. Find the value of magnetic energy stored in a loop of self-inductance L if I is the amount of current passing through it. 1+4=5

4. Answer the following questions : **(any one)**
10

(a) (i) Deduce an expression for the electric potential due to a uniformly charged thin spherical shell at an external and internal point. 5

(ii) Find out the expression for capacity of parallel plate capacitor. 5

(b) Derive the equation of continuity. What is its significance? 8+2=10
