Roll No. .....

B.Sc.Programme-II

Physics - Paper No. PH201

Physical Science
(Electricity, Magnetism and Electromagnetic Theory)

Time : 3 Hours Maximum Marks : 50

Question No. 1 is **compulsory** & attempt **four** other questions.

Q 1 Answer any four : $4 \times 2\frac{1}{2} = 10$

(a) Find the angle between $\mathbf{A} = 2\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $\mathbf{B} = 6\mathbf{i} - 3\mathbf{j} - \mathbf{k}$

(b) Determine the value of a so that $\mathbf{A} = 2\mathbf{i} + a\mathbf{j} + \mathbf{k}$ and $\mathbf{B} = 4\mathbf{i} - 2\mathbf{j} - 2\mathbf{k}$ are perpendicular.

(c) Given $\mathbf{R} = sint\ \mathbf{i} + cost\ \mathbf{j} + t\mathbf{k}$, find

$$\frac{d^2}{dt^2}\mathbf{R}$$

.

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

(e) If $\mathbf{A} = 2yz\mathbf{i} - x^2y\mathbf{j} + xz^2\mathbf{k}$ and $\mathbf{B} = x^2\mathbf{i} + yz\mathbf{j} - xy\mathbf{k}$, find $(\mathbf{B} \cdot \nabla)\mathbf{A}$.

Q 2 (a) If $\mathbf{v} = \omega \times \mathbf{r}$, prove $\omega = \frac{1}{2} curl \mathbf{v}$ 6

(b) Show that $\nabla r^n = nr^{n-2}\mathbf{r}$ 4

Q 3 (a) Find a unit normal to the surface $x^2y + 2xz = 4$ at the point $(2, -2, 3)$. 6

(b) Find $\nabla\phi$ if $\phi = \frac{1}{r}$. 4

Q 4 State the Gauss law in electrostatics. Using Gauss law find the electric field outside and inside a uniformly charged sphere of radius a. 10

Q 5 (a) Establish a relation between the electrostatic field and the electrostatic field. 5

(b) Find the electric field of a dipole in polar coordinates (r, θ). 5

Q 6 If $\mathbf{F} = 2y\mathbf{i} - z\mathbf{j} + x^2\mathbf{k}$ and S is the surface of the parabolic cylinder $y^2 = 8x$ in the first octant bounded $y = 4$ and $z = 6$, evaluate 10

$$\int\int_S \mathbf{F} \cdot \mathbf{n} ds$$