Del: (Nabla)

$$\nabla = \frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k} + \cdots$$

$\nabla = \frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k}$ Can be used as an operator.

jitni dimensions hon utni terms,

Can be Treated quadratic bridge!

as vector

Treated as Brain sends signals and

vectors remained trying!

Measures distance!

In communication,

frequencies Plays an imp

Role.

Del operator:

Del operators are not vector quantities ~~identically~~ identically but can be Treated as operator.

For a Differentiable fn U,

$$\text{Del } U = \left(\frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{j}\right) U$$

Now,

(i)

$$\left(\frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k}\right) U$$

$$\Rightarrow \text{Del } U = \frac{\partial U}{\partial x}\hat{i} + \frac{\partial U}{\partial y}\hat{j} + \frac{\partial U}{\partial z}\hat{k}$$

This is taken as gradient of the given diff fn U.

(ii)

$$\nabla \cdot U = \left(\frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k}\right) \cdot \left(U_1\hat{i} + U_2\hat{j} + U_3\hat{k}\right)$$

$$\Rightarrow \nabla \cdot U = \frac{\partial U_1}{\partial x} + \frac{\partial U_2}{\partial y} + \frac{\partial U_3}{\partial z}$$

This is taken as The divergence of any diff fn U.

Scanned with CamScanner

iii) Similarly,

$$\nabla \times U = \left[\frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k}\right] \times \left[U_1\hat{i} + U_2\hat{j} + U_3\hat{k}\right]$$

$$\nabla \times U = \left(\frac{\partial U_3}{\partial y} - \frac{\partial U_2}{\partial z}\right)\hat{i} + \left(\frac{\partial U_1}{\partial z} - \frac{\partial U_3}{\partial x}\right)\hat{j} + \left(\frac{\partial U_2}{\partial x} - \frac{\partial U_1}{\partial y}\right)\hat{k}$$

is taken as the curl of the given ftn. Taken as the rotating measure of the bodies.

eg hot air rolling (Tornado) water circulation in sea, streams river etc.

iv) Also we can extend the concept concern's of Del for the collection of vectors for.

$$\nabla(V_1 + V_2) = \nabla V_1 + \nabla V_2 \text{ etc}$$

v) $(\nabla \cdot \nabla)U = \left(\frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k} \cdot \frac{\partial}{\partial x}\hat{i} + \frac{\partial}{\partial y}\hat{j} + \frac{\partial}{\partial z}\hat{k}\right)U$

$$\Rightarrow \nabla^2 U = \frac{\partial^2 U}{\partial x^2} + \frac{\partial^2 U}{\partial y^2} + \frac{\partial^2 U}{\partial z^2}$$ = Laplacian of the ftn.

vi) Del is independent of the coord's system.

eg Must

Heart pump, jaise ke engine ka fan, or laptop ka fan. Cartesian se later cylindrical

if we have one D object then $\nabla \to \Delta$