

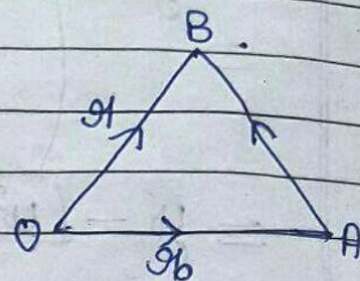
## Tangent Plane and Normal line :-

Equation of tangent plane is —

$$\boxed{(\vec{a} - \vec{a}_0) \cdot \text{grad} f = 0}$$

$$\vec{AB} = \vec{OB} - \vec{OA}$$

$$\vec{AB} = \vec{a} - \vec{a}_0$$



Equation of normal line is —

$$\boxed{(\vec{a} - \vec{a}_0) \times \text{grad} f = 0}$$

- Q. Find the equation of the tangent plane and normal line to the surface  $xyz=4$  at the point  $(1,2,2)$

Eq<sup>n</sup> of tangent plane  $\rightarrow (\vec{a} - \vec{a}_0) \cdot \text{grad} f = 0$

$$f = xyz - 4$$

$$\nabla f = \hat{i}yz + \hat{j}xz + \hat{k}xy$$

$$\text{At } (1,2,2) \nabla f = 4\hat{i} + 2\hat{j} + 2\hat{k}$$

$$\begin{aligned} \vec{a} - \vec{a}_0 &= (x\hat{i} + y\hat{j} + z\hat{k}) - (1\hat{i} + 2\hat{j} + 2\hat{k}) \\ &= (x-1)\hat{i} + (y-2)\hat{j} + (z-2)\hat{k} \end{aligned}$$

Eq<sup>n</sup> of tangent plane  $\rightarrow$

$$(\vec{a} - \vec{a}_0) \cdot \text{grad} f = 0$$

$$4(x-1) + 2(y-2) + 2(z-2) = 0$$

$$2x - 2 + y - 2 + z - 2 = 0$$

$$2x + y + z = 6 \quad \underline{\text{Ans}}$$



Eq<sup>n</sup> of normal line  $\rightarrow (\vec{a} - \vec{a}_0) \times \text{grad} f = 0$

$$(\vec{a} - \vec{a}_0) \times \text{grad} f = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ x-1 & y-2 & z-2 \\ 4 & 2 & 2 \end{vmatrix} = 0$$

$$\Rightarrow 2(y-2-z+2) - 2j(x-1-2z+4) + 2k(x-1-2y+4) = 0$$

$$\Rightarrow 2i(y-2) - 2j(x-2z+3) + 2k(x-2y+3) = 0$$

$$(y-2)i - j(x-2z+3) + k(x-2y+3) = 0i + 0j + 0k$$

$$y-2=0$$

$$x-2z+3=0$$

$$y=z$$

$$x-2y+3=0$$

$$y-2=z-2, \quad 2(z-2)=x-1$$

$$(x-1)=2(y-2)$$

$$\frac{y-2}{1} = \frac{z-2}{2}, \quad \frac{z-2}{2} = \frac{x-1}{2}$$

$$\frac{x-1}{2} = \frac{y-2}{1}$$

$$\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-2}{1} \quad \text{Ans}$$