WAVE OPTICS

WAVE FRONT

- Wave front is a locus of particles having same phase.
- Direction of propagation of wave is perpendicular to wave front.
- Every particle of a wave front acts as a new source and is known as secondary wavelet.

Coherent source

If the phase difference due to two source at a particle point remains constant with time, then the two sources are considered as coherent source

INTERFERENCE

$$A_{net}^2 = A_1^2 + A_2^2 + 2A_1A_2\cos\phi$$

$$I_{net} = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$$

For constructive interference

$$I_{net} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$$

For destructive interference

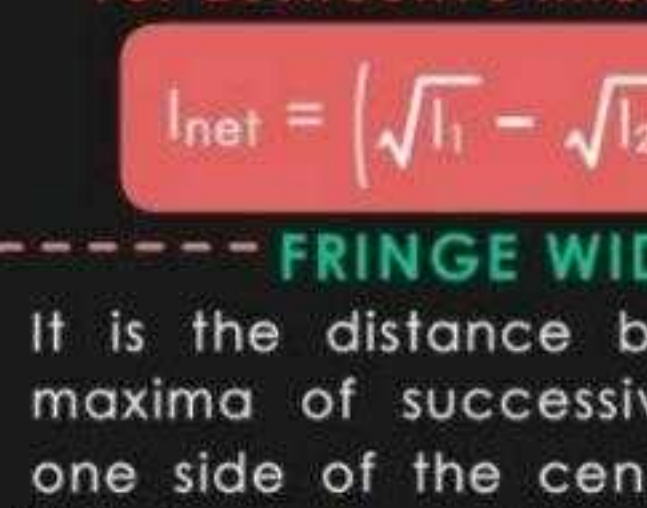
$$I_{net} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$$

FRINGE WIDTH

It is the distance between two maxima of successive order on one side of the central maxima. This is also equal to the distance between two successive minima.

$$\beta = \frac{\lambda D}{d}$$

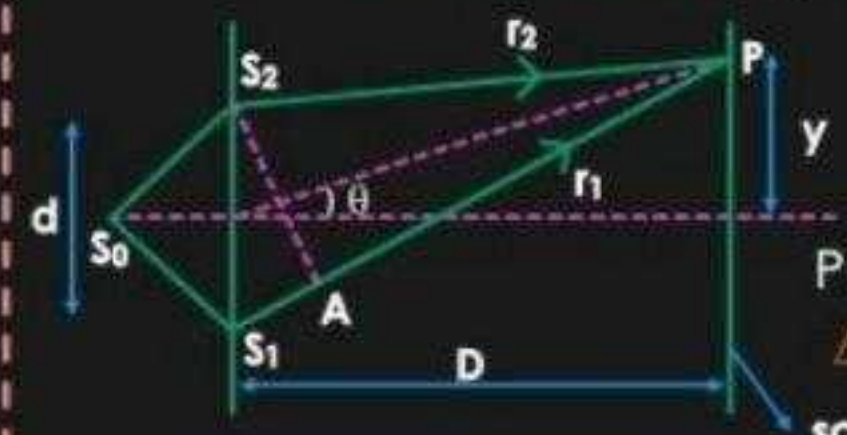
DISPLACEMENT OF FRINGE



for central bright fringe;

$$\frac{yd}{D} = t(\mu - 1)$$

YOUNG'S DOUBLE SLIT EXPERIMENT (Y.D.S.E)



Path difference

$\Delta p = S_1P - S_2P$

$$\sqrt{\left(y + \frac{d}{2}\right)^2 + D^2} - \sqrt{\left(y - \frac{d}{2}\right)^2 + D^2} \quad ...(1)$$

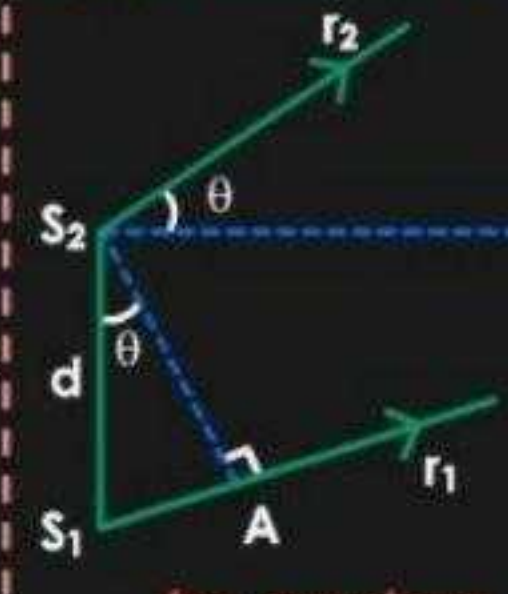
Approximation I :

For $D >> d$, We can approximate rays $\vec{r_1}$ and $\vec{r_2}$ as being approximately parallel, at angle θ to the principle axis.

Now, $S_1p - S_2P = S_1A = S_1S_2\sin\theta$

$\Rightarrow$ Path difference = $d\sin\theta$ ...(2)

Approximation II :



Further if θ is small, i.e.

$y << D$, $\sin\theta \simeq \tan\theta = \frac{y}{D}$

and hence,

path difference = $\frac{dy}{D}$ ..(3)

for maxima

$$\Delta p = \frac{dy}{D} = n\lambda$$

for minima

$$\Delta p = \pm\frac{\lambda}{2}, \pm\frac{3\lambda}{2} \pm\frac{5\lambda}{2}$$