Wave optics

Wavefront	Shape of light src	Variation of Amplitude with distance	Variation of Intensity with distance
Spherical	Point Source	$A \propto \frac{1}{d}$ or $A \propto \frac{1}{r}$	$I \propto \frac{1}{d^2}$ or $I \propto \frac{1}{r^2}$
Cylindrical	Linear Source	$A \propto \frac{1}{\sqrt{d}}$ or $A \propto \frac{1}{\sqrt{r}}$	$I \propto \frac{1}{d}$ or $I \propto \frac{1}{r}$
Plane	Extended large source	$A = const,$	$I = const.$

Important Formula's to be remembered :→

$I \propto A^2$ or $A \propto \sqrt{I}$

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

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

For Maximum

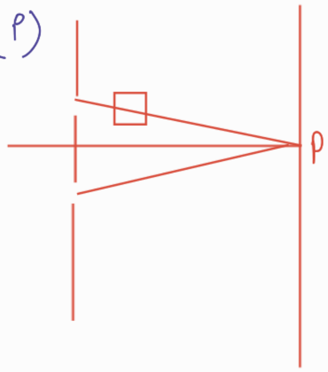
$A_1 = A_2 = A_0$, then $\rightarrow A_{res} = 2A\cos(\phi/2)$

$I_1 = I_2 = I_0$ then $\rightarrow I_{res} = 4I_0\cos^2(\phi/2)$

Maximum Intensity [Constructive]	Minimum Intensity [Destructive]
$\phi = 2n\pi$, $\Delta x = n\lambda$	$\phi = (2n-1)\pi$, $\Delta x = (2n-1)\frac{\lambda}{2}$
$I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$	$I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$
$A_{max} = (A_1 + A_2)$	$A_{max} = A_1 - A_2$
Maximum	Minimum
$\Delta\phi = \frac{2\pi}{\lambda}(\Delta x)$	$\Delta\phi = \frac{2\pi}{\lambda}(\Delta x)$

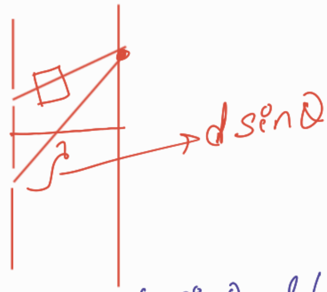
Thin slab in path

(i)



Here, $\Delta x = (\mu - 1)t$

(ii)



Here, $\Delta x = d\sin\theta - t(\mu - 1)$

Position of CM $\boxed{\Rightarrow y = \dfrac{tD}{d}(\mu - 1)}$

(*) No. of fringes shift $= \dfrac{y_{shift}}{\beta}$

Oblique Incidence :-

$\cancel{d}\sin\alpha = \cancel{d}\sin\theta$

$\boxed{\Rightarrow \sin\alpha = \sin\theta}$

Interference in Thin films :-

(A) Reflected wave :-

$\Delta x = 2\mu t - \dfrac{\lambda}{2}$

(B) Transmitted wave :-

$\Delta x = 2\mu t$

(*) Substitute Δx, accordingly.

YDSE Experiment

(*) $\Delta x = d\sin\theta \xrightarrow{\text{maxima}} n\lambda = d\dfrac{y}{D}$ $\boxed{\Rightarrow y = \dfrac{n\lambda D}{d}}$

$\xrightarrow{\text{minima}} (2n-1)\dfrac{\lambda}{2} = d\dfrac{y}{D} \Rightarrow y = (2n-1)\dfrac{\lambda D}{2d}$

Fringe width, $\beta = \dfrac{\lambda D}{d}$ { Distance b/w 2 consecutive minima or maxima }.

(*) Angular fringe width,

$$\beta_{ang} = \frac{\beta}{D} = \frac{\lambda \cancel{D}}{\cancel{D}d} = \frac{\lambda}{d}$$

(*) $n < \dfrac{d}{\lambda}$ { required for the counting of minima or maxima }.

Angular fringe width in liquid, $\longrightarrow \beta = \dfrac{\lambda}{\mu D}$, { μ = refractive index of that medium }

(*) Optical Path $= \mu \times$ Geometrical path

Simple slit diffraction :-

$a \sin\theta = n\lambda$ ⟶ Condition for minima

$a \sin\theta = (2n+1)\frac{\lambda}{2}$ ⟶ Condition for maxima

* Central Bright fringe / central envelope $(C.M) = \frac{2\lambda D}{a}$
* other fringes ⟶ $\frac{\lambda D}{a}$.

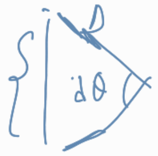
Rayleigh's Criteria for Resolution :-

(A) Telescope ⟶

$R.L = \frac{1.22\lambda}{a}$, $R.P = \frac{a}{1.22\lambda}$ ⟶ apperture of objective lens

$(d\theta)$

also, ΔL



, $\Delta L = D\, d\theta$

(B) Microscope :-

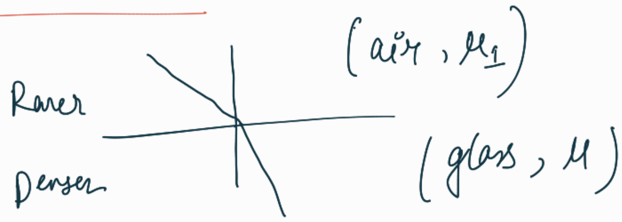
$d_{min} = \frac{0.61\lambda}{\mu \sin\theta}$

$R.P = \frac{(\mu \sin\theta)}{0.61 \times \lambda}$ ⟶ Numerical apperture

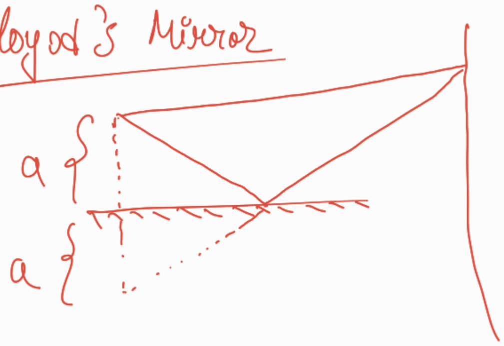
Polarisation ⟶ Read from class notes

Brewster Angle / Angle of Polarisation :-

$\tan\theta_p = \frac{\mu}{\mu_1}$ ⟶

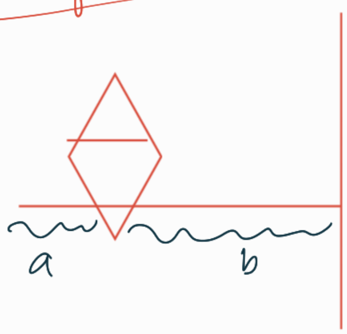


Lloyd's Mirror



Here, $\beta = \frac{\lambda D}{2a}$

Fresnel's Biprism



Here, $\beta = \frac{\lambda D}{d} = \frac{\lambda D}{a+b}$