Wave Optics

Coherent Sources

Two sources are said to be coherent if they have exactly same frequency and zero or constant phase difference.

Addition Of Coherent Wave

Resultant intensity

Fr bright fringes,

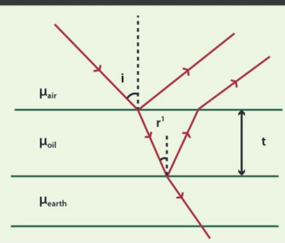
$I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2$ at $\Phi = 0, 2\pi, 4\pi...$

Fr dark fringes,

$I_{min} = (\sqrt{I_1} - \sqrt{I_2})^2$ at $\Phi = 0, 3\pi, 5\pi...$

$I_1 = I_2 = I_O;\ I_R = 4I_O\cos^2(\Phi/2)$

Interference In Thin Film



For reflected light

Maxima → $2\mu t\cos r = (2n+1)\frac{\lambda}{d}$

Minima → $2\mu t\cos r = n\lambda$

For transmitted light

Maxima → $2\mu t\cos r = n\lambda$

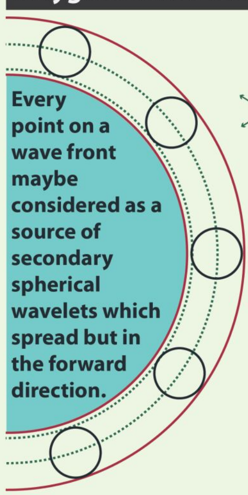
Minima → $2\mu t\cos r = (2n+1)\frac{\lambda}{d}$

Shift in fringe pattern

$\Delta x = \frac{\beta}{\lambda}(\mu-1)t = \frac{D}{d}(\mu-1)t$

(μ = R.I of the film)

Huygens Wave Theory



Doppler's Effect

Apparent frequency received during relative motion of source and observer

$\gamma' = \gamma(1-\frac{v}{c})$; (red shift)

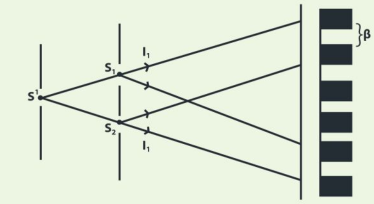
$\gamma' = \gamma(1+\frac{v}{c})$; (blue shift)

Doppler shift

$\Delta\gamma = \pm\frac{v}{c} \times \gamma$

$\Delta\lambda = \pm\frac{v}{c} \times \lambda \Rightarrow \lambda' - \lambda = \pm\frac{v}{c} \times \lambda$

Interference Of Light



The superposition of two coherent waves resulting in a pattern of dark and bright fringes of equal width.

Position of bright fringe $x_n = \frac{n\lambda D}{d}$

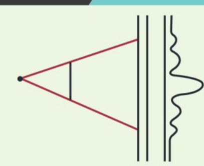
Position of dark fringe $x_n^1 = \frac{(2n-1)\lambda D}{2d}$

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

Ratio of slit width with intensity

$\frac{\omega_1}{\omega_2} = \frac{I_1}{I_2} = \frac{a_1^2}{a_1^2}$

Diffraction



Single slit experiment

Angular position of n^{th} mininma,

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

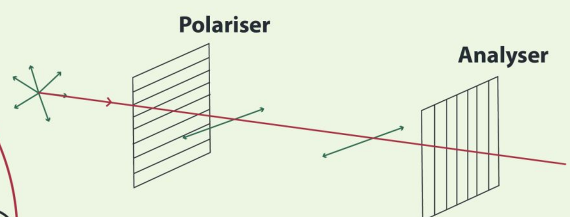
Angular position of n^{th} mininma,

$\theta_n = \frac{(2n+1)\lambda}{2d}$

Width of central maximum,

$\beta_o = 2\beta = \frac{\lambda D}{d}$

Polarisation Of Light



Malu's Law

The intensity of transmitted light passed through an analyser is

$I = I_o\cos^2\theta$

(θ = angle between transmission directions of polariser and analyser)

Polarisation By Reflection

Brewster's Law

The tangent of polarising angle of incidence at which reflected light becomes completely plane polarised is numerically equal to refractive index of the medium.

$\mu = \tan i_p$

&

$i_p + r_p = 90^\circ$ (i_p = Brewster's angle)