**Introduction to Wave Optics**

Wave optics, also known as physical optics, is a fascinating branch of physics that explores the wave nature of light. Unlike geometric optics, which treats light as rays, wave optics delves into phenomena that arise due to the wave characteristics of light, such as interference, diffraction, and polarization.

In this chapter, you will learn about:

1. **Huygens’ Principle**: This principle helps us understand how wavefronts propagate and how light waves interact with obstacles.
2. **Interference of Light**: The phenomenon where two or more light waves superimpose to form a resultant wave of greater, lower, or the same amplitude.
3. **Young’s Double-Slit Experiment**: A classic experiment that demonstrates the interference pattern of light and provides evidence for the wave nature of light.
4. **Diffraction**: The bending of light waves around obstacles and the spreading of light waves when they pass through small openings.
5. **Polarization**: The orientation of light waves in particular directions, which is not explained by the ray model of light.

`R = sqrt(A\_{1}^2 + A\_{2}^2 + 2A\_{1}A\_{2}cosphi)`

`R = 2Acosphi/2`

`I = I\_{1} + I\_{2} + 2 sqrt(I\_{1}I\_{2})cosphi`

`I = 4I\_{0}cos^2phi/2`

Constructive interference

`phi = 2npi `

`R = A\_{1} + A\_{2}`

`I = ((sqrt(I\_{1}) + sqrt(I\_{2}))^2)`

`delta = nlambda`

`phi = (2pi)/lambda delta`

destructive interference

`phi = (2n +1)pi`

`R = A\_{1} – A\_{2}`

`I = ((sqrt(I\_{1}) - sqrt(I\_{2}))^2)`

`delta = (2n – 1)lambda/2`

Young’s Double-Slit Experiment (YDSE)

Bright fringe: `4I\_{0}`

Dark fringe: `I = 0`

`delta = (dx)/D`

x = distance from center d = distance between slits D = distance between screen and slit

`phi = (2pi)/lambda \* (dx)/D`

distance of nth fringe from C(center of screen)

`(dx)/D = nlambda`

Bright: `x = (nlambdaD)/d

dark: `x = ((2n-1)lambdaD)/(2d)`

Fringe width

`Beta = (lambdaD)/d = lambda\_{nB} – lambda\_{(n-1)B}`

Tilted source

`(dx)/D = dsintheta`

In medium

`Lambda rightarrow lambda/mu`

`v =c/mu`

`beta’ = beta/mu`

Shift

&image&

C

t μ

`t(mu – 1) = (dx)/D`

`x = (Dt(mu – 1 ))/d`

t is the thickness of medium placed in front of one slit

if two medium of same thickness, but different `mu` values each placed in front of either of the waves

&image&

t μ1

C

t μ2

`t(mu\_{1} – mu\_{2}) = (dx)/D`

brewsters angle

`mu = tantheta`

`theta` = brewsters angle