

# Interference of Light

B.Tech -I

# Light's Nature

- Wave nature (electromagnetic wave)
- Particle nature (bundles of energy called photons)

# Wave or Particle Nature

- **Corpuscular theory of Newton (1670)**
- Light corpuscles have mass and travel at extremely high speeds in straight lines
  
- **Huygens (1680)**
- Wavelets-each point on a wavefront acts as a source for the next wavefront

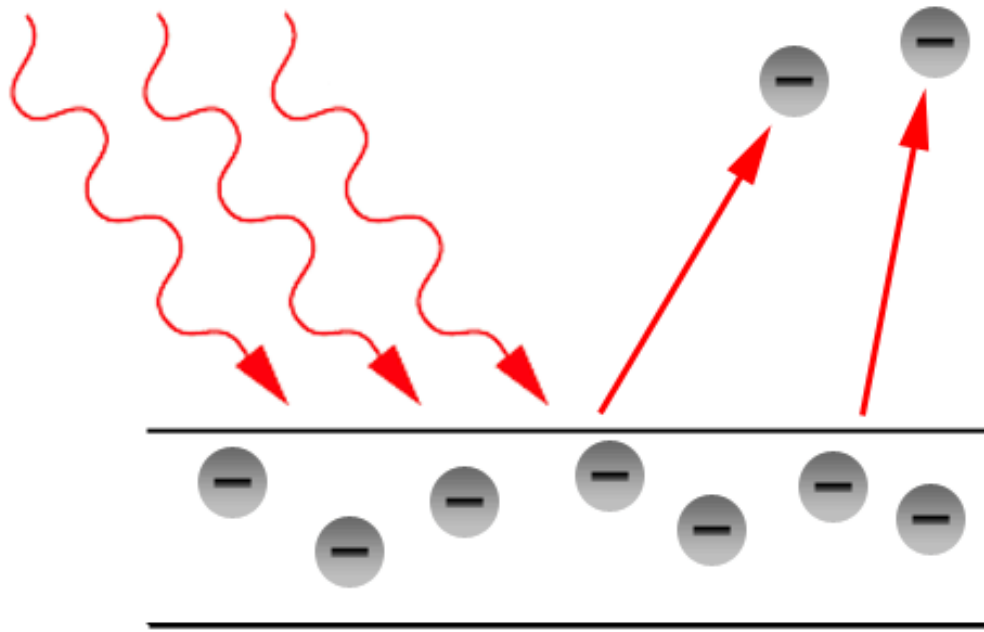
# Wave Nature

- **Thomas Young's Double Slit Experiment (1807)**  
bright (constructive) and dark (destructive)  
fringes seen on screen
- **Thin Film Interference Patterns**



# Particle Nature: The Photoelectric Effect

- Albert Einstein 1905
- Light energy is quantized
- Photon is a quantum or packet of energy



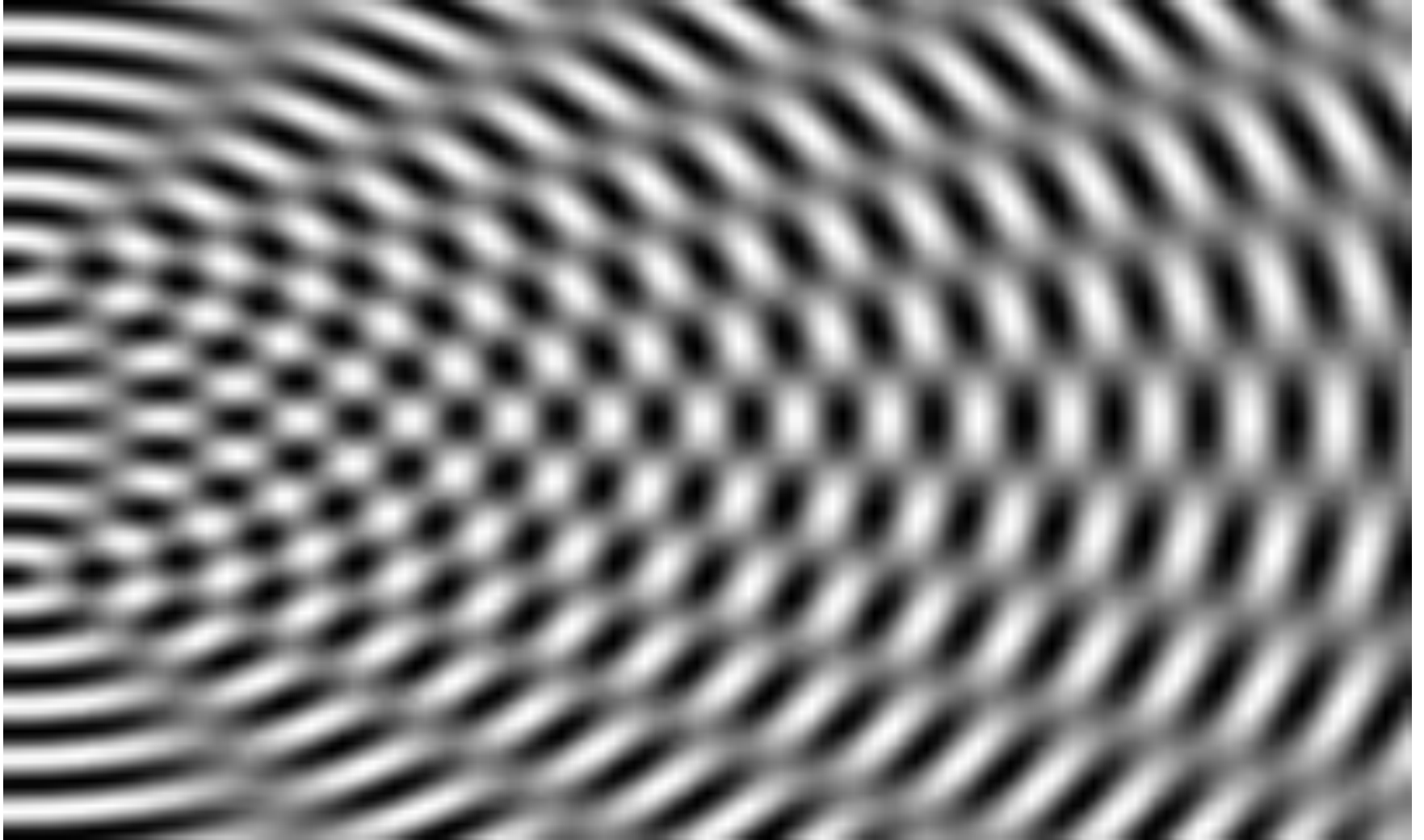
# The Photoelectric Effect

- **Heinrich Hertz** first observed the **photoelectric effect** in 1887
- Einstein explained it in 1905 and won the Nobel prize for this.

# Thomas Young's Double Slit Interference Experiment

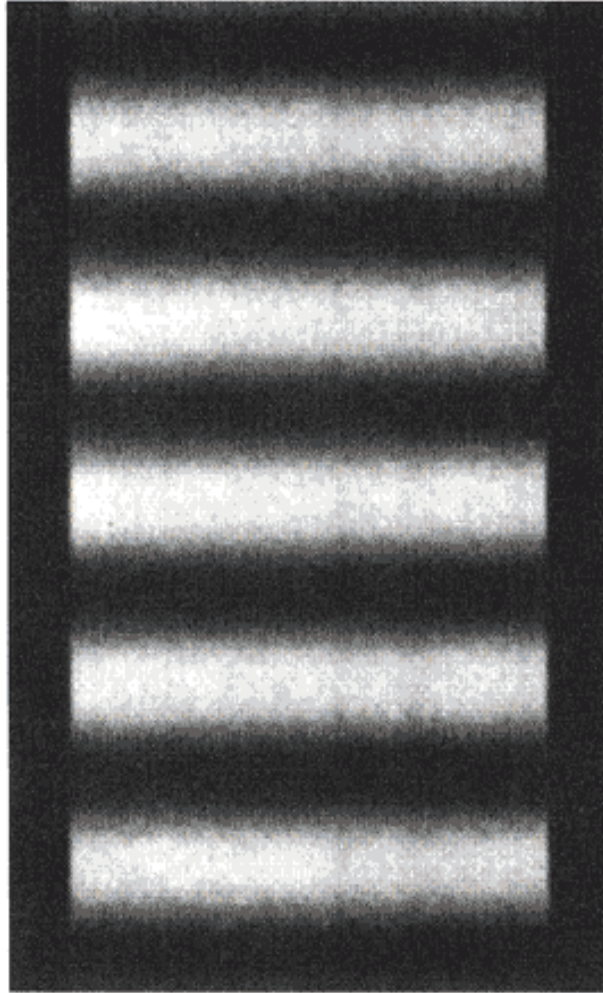
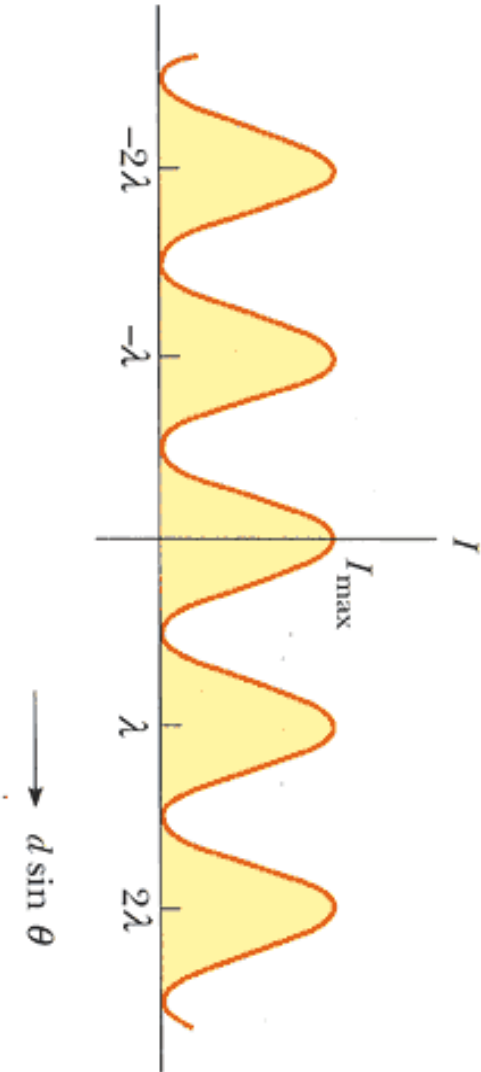
- Showed an interference pattern
- Measured the wavelength of the light

# Two Waves Interfering

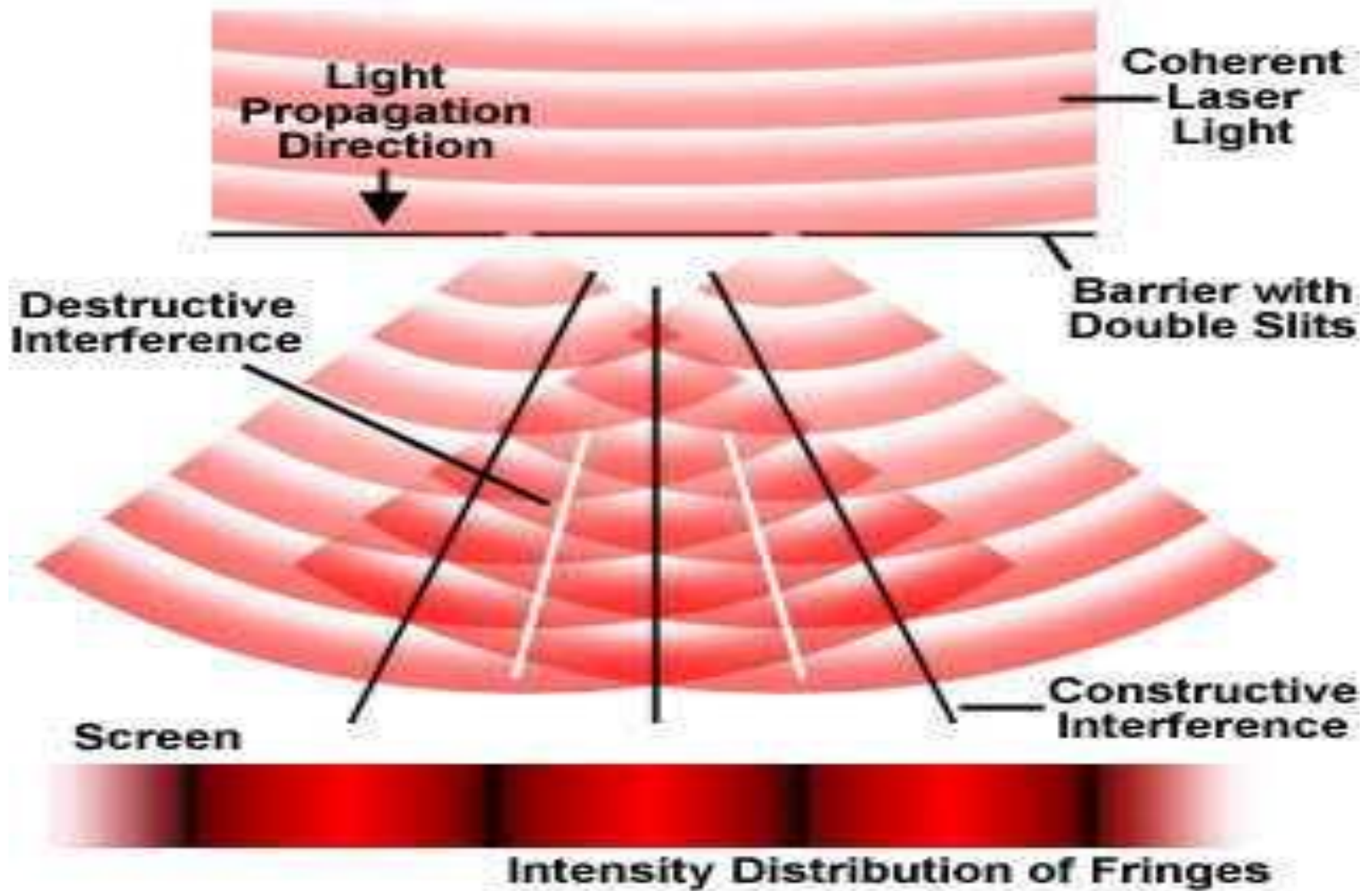




# Young's Double Slit Interference Pattern



# Young's Double Slit Experiment



# Interference

- Young's Double Slit Interference

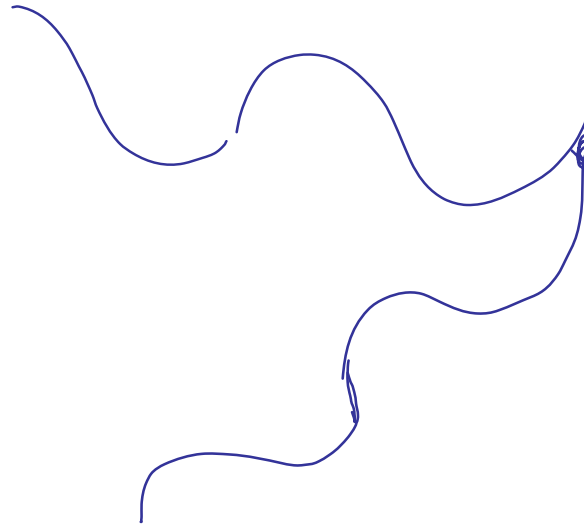
# For Constructive Interference:

The waves must arrive to the point of study in phase.

So their path difference must be integral multiples of the wavelength:

$$\Delta L = n\lambda$$

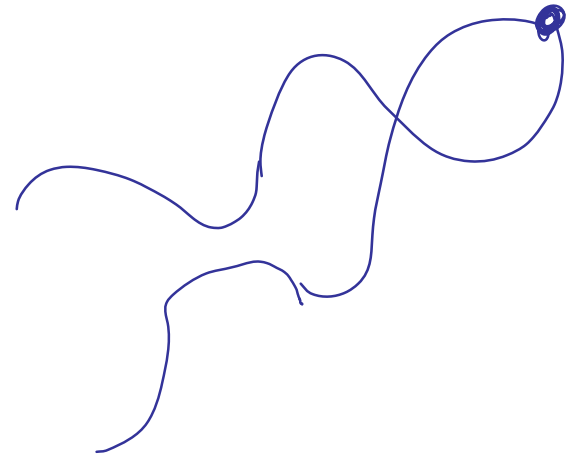
$$n = 0, 1, 2, 3, \dots$$



# For destructive interference:

, the waves must  
arrive to the point of  
study out of phase.

So the path difference  
must be an odd  
multiple of  $\lambda/2$ :



$$\Delta L = n \lambda$$

$$m = 1/2, 3/2, 5/2, \dots$$

# For Constructive Interference of Waves from Two Sources

$$x = L \tan \theta$$

$$\sin \theta = \Delta L / d$$

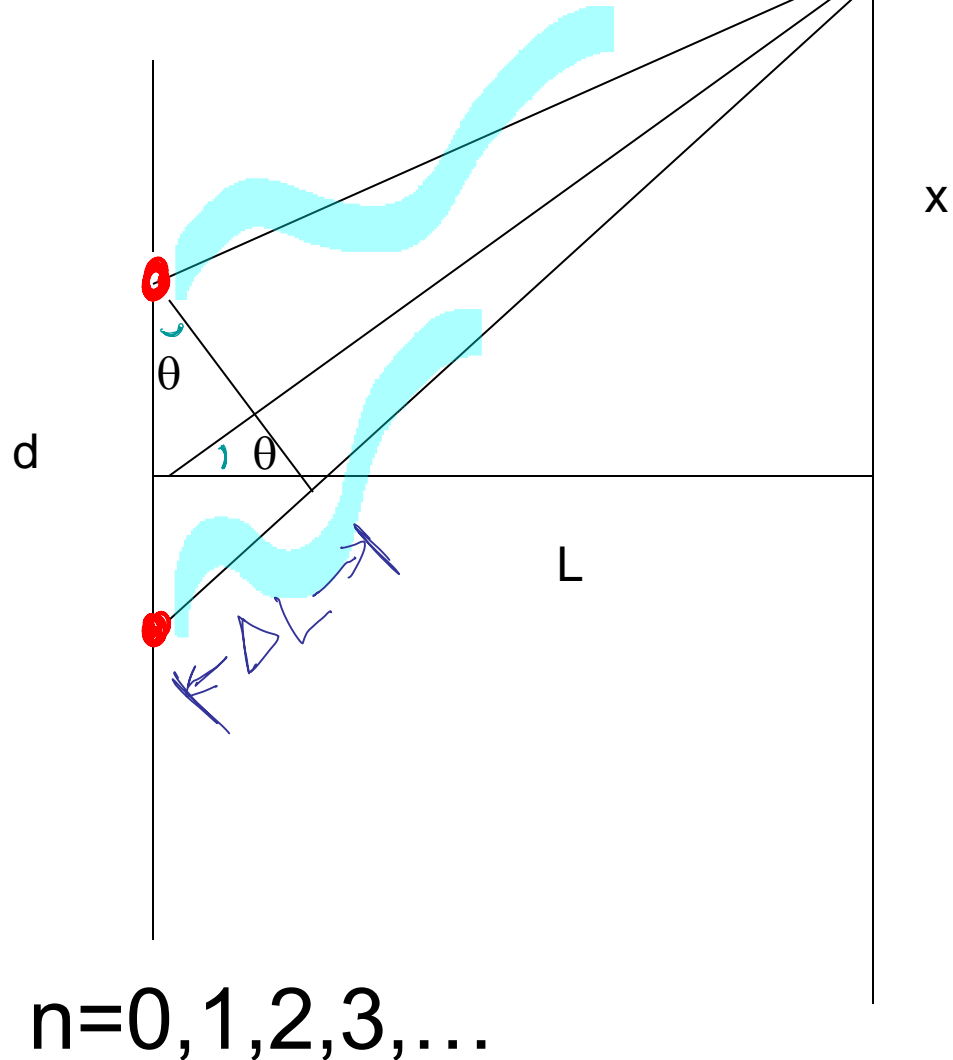
$$\Delta L = n \lambda$$

For small angles:

$$L \sin \theta \sim L \tan \theta$$

$$d \sin \theta = n \lambda$$

$$n \lambda = \frac{dx}{L}$$



# Double Slit Interference

$$d \sin \theta = n \lambda$$

$$n \lambda = \frac{dx}{L}$$

Constructive (brights)  $n=0, 1, 2, 3, \dots$

Destructive (darks)  $n=1/2, 3/2, 5/2, \dots$

Note:

To find maximum # of fringes set  $\theta$  to  $90^\circ$  for  $n$ .