# Light Waves

## Diffraction of light

### Single Slit Diffraction

$$a \sin\theta_0 = 0 \quad (Central\ maximum)$$

$$a \sin\theta_m = (m + \frac{1}{2})\lambda \quad m = 1, 2, 3, \ldots (maximum)$$

$$a \sin\theta_m = m\lambda \quad m = 1, 2, 3, \ldots (minimum)$$

### Diffraction grating

Grating constant $d = \frac{1}{N} = a + b$

$$d \sin\theta_m = m\lambda \quad m = 0, 1, 2, 3, \ldots (maximum)$$

$$d \sin\theta_m = (m + \frac{1}{2})\lambda \quad m = 1, 2, 3, \ldots (minimum)$$

$$\sin\theta_m = \frac{m\lambda}{d} \leq 1$$

$$m \leq \frac{d}{\lambda}$$

## Polarization of light

Polarizer or Poloriod is a transparent plastic sheet on which particles are deposited in a series of parallel lines. Natural crystals such as tourmaline, calcite and quartz are used as polariser

Only transverse waves can be polarised

## Inteference of light

### Conditions

- Coherent sources
- Sources close to each other
- Amplitude of source same/almost same

### Constructive and destructive inteference

Constructive:

$$o.p.d. = m\lambda \quad m = 0, 1, 2, 3, \ldots$$

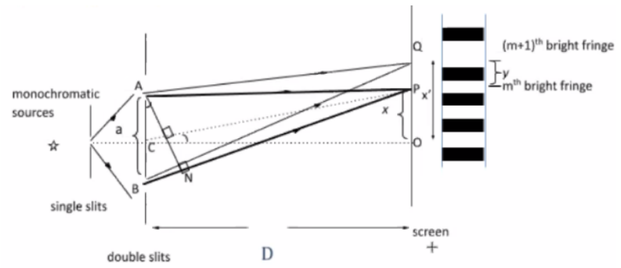
$$\phi = 2m\pi \quad m = 0, 1, 2, 3, \ldots$$

Destructive:

$$o.p.d. = (m \pm \frac{1}{2})\lambda \quad m = 0, 1, 2, 3, \ldots$$

$$\phi = (2m + 1)\pi \quad m = 0, 1, 2, 3, \ldots$$

### Young's double-slit interference




Bright fringes:

$$a \sin\theta_m = m\lambda \quad m = 0, 1, 2, 3, \ldots$$

Dark fringes:

$$a \sin\theta_m = (m \pm \frac{1}{2})\lambda \quad m = 0, 1, 2, 3, \ldots$$

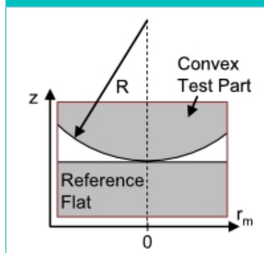
$$\theta \approx 0$$

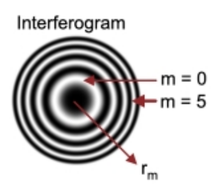
$$\sin\theta_m \approx \tan\theta_m$$

$$\tan\theta_m = \frac{x}{D}$$

$$y = \frac{D\lambda}{a}$$

### Newton's Rings




$$\frac{r^2}{R} = (m \pm \frac{1}{2})\lambda \quad m = 0, 1, 2, 3, \ldots \quad (bright)$$

$$\frac{r^2}{R} = m\lambda \quad m = 0, 1, 2, 3, \ldots \quad (dark)$$

### Thin wedge film interference

Phase change when reflected at an optically denser medium

Case 1:

$(n_2 > n_1\ and\ n_2 > n_3)\ or\ (n_2 < n_1\ and\ n_2 < n_3)$

$$2n_2t = (m + \frac{1}{2})\lambda \quad m = 0, 1, 2, 3, \ldots \quad (bright)$$

$$2n_2t = m\lambda \quad m = 0, 1, 2, 3, \ldots \quad (dark)$$

Case 2:

$(n_1 < n_2 < n_3)\ or\ (n_1 > n_2 > n_3)$

$$2n_2t = m\lambda \quad m = 0, 1, 2, 3, \ldots \quad (bright)$$

$$2n_2t = (m + \frac{1}{2})\lambda \quad m = 0, 1, 2, 3, \ldots \quad (dark)$$