Example 8.3. *In Young's double slit experiment the separation of the slits is 1.9* mm *and the fringe spacing is 0.31* mm *at a distance of 1 metre from the slits. Calculate the wavelength of light.*

Here

$$\beta = 0.31 \text{ mm} = 0.031 \text{ cm}$$

$$d = 1.9 \text{ mm} = 0.19 \text{ cm}$$

$$D = 1 \text{ m} = 100 \text{ cm}$$

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

or

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

$$\lambda = \frac{0.031 \times 0.19}{100}$$

$$\lambda = 5890 \times 10^{-8} \text{ cm} = \mathbf{5890 \text{ Å}}$$

Example 8.46. *A thin equiconvex lens of focal length 4 metres and reflective index 1.50 rests on and in contact with an optical flat, and using light of wavelength 5460 Å, Newton's rings are viewed normally by reflection. What is the diameter of the 5 th bright ring ?*

The diameter of the n th bright ring is given by

$$D_n = \sqrt{2(2n-1)\lambda R}$$

Here $n = 5, \quad \lambda = 5460 \times 10^{-8}$ cm

$$f = 400 \text{ cm}, \quad \mu = 1.50$$

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

Here $R_1 = R, \quad R_2 = -R$

$\therefore$ $$\frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right)$$

$$\frac{1}{400} = (1.50 - 1)\left(\frac{2}{R}\right)$$

$$R = 400 \text{ cm}$$

$\therefore$ $$D_n = \sqrt{2 \times (2 \times 5 - 1) \times 5460 \times 10^{-8} \times 400}$$

$$D_n = \mathbf{0.627 \text{ cm}}$$

Example 8.47. A *plano-convex lens of radius 300* cm *is placed on an optically flat glass plate and is illuminated by monochromatic light. The diameter of the 8 th dark ring in the transmitted system is 0.72* cm. *Calculate the wavelength of light used.*

[*Delhi B.Sc.(Hons) 1986*]

For the transmitted system,

$$r^2 = \frac{(2n-1)\lambda R}{2}$$

Here $n = 8$, $D = 0.72$ cm, $r = 0.36$ cm

$R = 300$ cm, $\lambda = ?$

$$\lambda = \frac{2r^2}{(2n-1)R} = \frac{2 \times (0.36)^2}{(2 \times 8 - 1)\,300}$$

$$= 5760 \times 10^{-8} \text{ cm}$$

or $\lambda = \mathbf{5760\ Å}$

Example 10.2. *Calculate the thickness of a half wave plate of quartz for a wavelength of 5000 Å. Here $\mu_E = 1.553$ and $\mu_0 = 1.544$.*

(*Delhi*)

For a half wave plate,

$$t = \frac{\lambda}{2[\mu_E - \mu_0]}$$

Here $\lambda = 5000 \text{ Å} = 5 \times 10^{-5} \text{ cm}$

$$\mu_E = 1.553, \ \mu_0 = 1.544, \ t = ?$$

$$\therefore \quad t = \frac{5 \times 10^{-5}}{2[1.553 - 1.544]}$$

or $\quad t = \mathbf{2.78 \times 10^{-3}}$ **cm**

Example 10.3. *Plane-polarized light passes through a quartz plate with its optic axis parallel to the faces. Calculate the least thickness of the plate for which the emergent beam will be plane-polarized.*

Given

$\mu_E = 1.5533$, $\mu_0 = 1.5442$ *and* $\lambda = 5 \times 10^{-5}$ cm **(*Punjab*)**

$$t = \frac{\lambda}{2(\mu_E - \mu_0)}$$

$$= \frac{5 \times 10^{-5}}{2(1.5533 - 1.5442)}$$

$$= \mathbf{2.75 \times 10^{-3} \text{ cm}}$$