Q.1. In a Double slit experiment a light of $\lambda = 5460\,\mathring{A}$ is exposed to slit which are 0.1 mm apart. The screen is placed 2 m away from the slit. what is angular position of 10 maximum and 1 minimum.

Ans. given $\lambda = 5460\,\mathring{A}$

$2d = 0.1\text{ mm}$

$D = 2\text{ m}$

Condition for maximum Intensity

$$x_n = \frac{n\lambda D}{2d}$$

for 10th maximum $n = 10$

put the value

$$x_n = \frac{10 \times 5460 \times 2}{1 \times 10^{-4}}$$

$$= 0.1092\text{ m}$$

10th maximum angular position

$$\tan\phi_{10} = \frac{x_{max\,10}}{D}$$

$$= \frac{0.1092}{2}$$

$$= 0.0546 \text{ radian}$$

Condition for minimum Intensity

$$x_n = \frac{(2n-1)\lambda D}{2d}$$

Teacher's Signature :

Distance of 1th minimum

$$x_{min1} = \frac{\lambda D}{4d}$$

$$= \frac{5460 \times 10^{-10} \times 2}{2 \times 10^{-4}}$$

angular position of 1st minimum

$$\tan\phi = \frac{x_{min}}{D}$$

$$= \frac{5460 \times 10^{-6}}{2}$$

Q. A soap film of r.I = 1.33 and thickness 5000°A is exposed to white light what wavelength in visible region are reflected.

Solution

$\mu = 1.33$

$t = 5000 \times 10^{-10}$

$2\mu t \cos r - \frac{\lambda}{2} = n\lambda$ · for max reflection $\cos r = 1$

$$2\mu t - \frac{\lambda}{2} = n\lambda$$

$$\lambda = \frac{4\mu t}{2(n+1)}$$

$$\lambda = \frac{4 \times 1.33 \times 5000 \times 10^{-10}}{2n+1} = \frac{26600 \times 10^{-10}}{2n+1}$$

for $n = 0$ $\lambda_1 = 26600 \times 10^{-10}$ (IR)

$n = 1$ $\lambda_2 = 8666.67 \times 10^{-10}$ (IR)

$\lambda_3 = 5320 \times 10^{-10}$ (visible)

$\lambda_4 = 3800 \times 10^{-10}$ (U.V)

Q.3. In a Newton rings experiment the diameter of 15th ring was found to be 0.59 cm and that of 5th ring is 0.336 cm. If the radius of curvature of lens is 100 cm. Find the wavelength of light.

Solution $D_{15} = 0.59\,cm = .59 \times 10^{-2}\,m$

$D_5 = 0.336\,cm = 0.336 \times 10^{-2}\,m$

$R = 100\,cm = 1\,m$

Formula $\lambda = \dfrac{D_{n+m}^2 - D_n^2}{4mR}$

$$= \frac{(0.59 \times 10^{-2})^2 - (0.336 \times 10^{-2})^2}{4 \times 10 \times 1}$$

$= 5880 A$

Q.4. Neuton Rings are observed in reflected light of wave length 5900 °A. The diameter of 10th dark ring is 0.5 cm. Find the radius of curvature of lens used.

Sol —

$\lambda = 5900\,°A$

$D_{10}(\text{dark}) = 0.5 \times 10^{-2}\,m$

$R = ?$

Formula $D_n^2 = 4n\lambda R$

$$R = \frac{D_n^2}{4n\lambda} = \frac{(0.5 \times 10^{-2})^2}{4 \times 10 \times 5900 \times 10^{-10}}$$

$$= 1.059\,m.$$

Q.5. Light waves of wavelength 650 nm and 500 nm produce interference fringes on screen at a distance of 1m from double slit of seperation 0.5 mm find the least distance of a point from the central maximum where the bright fringe due to both sources coincide

Solution

wavelength of first source $\lambda_1 = 650\,nm$

wavelength of second source $\lambda_2 = 500\,nm$

Scanned with CamScanner

Distance of screen = 1 m

separation b/w slits $2d = 0.5\,mm = 0.5 \times 10^{-3}\,m$.

Distance from central maxima where the bright fringes due to both source coincide $(x) = ?$

$$x = \frac{n\lambda_1 D}{2d} = \frac{m\lambda_2 D}{2d}$$

or $n\lambda_1 = m\lambda_2$

$$\frac{n}{m} = \frac{\lambda_2}{\lambda_1} = \frac{500}{650} = \frac{10}{13}$$

10th bright fringe due to first source coincide with 13th bright fringe due to second source

$$x = \frac{n\lambda_1 D}{2d} = \frac{10 \times 650 \times 10^{-9} \times 1}{0.5 \times 10^{-3}} = 0.013\,m$$

$= 13\,mm.$