SAP ID - 60004200192
Name - Ayush Jain
DATE:

25/04/2021

Engineering Physics

Tutorial - 6

1) $d_5 = 0.30\ cm$

$d_{15} = 0.62\ cm$

$d_{25} = ?$

→ $D_n^2 = 4n\lambda R$

$\therefore D_{15}^2 = 60\lambda R$ - (1)

$D_5^2 = 20\lambda R$ - (2)

(1) - (2) $40\lambda R = D_{15}^2 - D_5^2$

$\therefore \lambda R = \frac{D_{15}^2 - D_5^2}{40} = \frac{(0.62)^2 - (0.3)^2}{40}$ - (3)

$D_{25}^2 = 100\lambda R$ - (4)

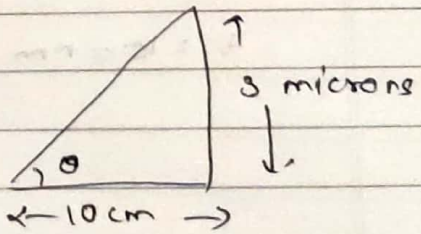
(4) - (1) = $80\lambda R = D_{25}^2 - D_5^2$

$2D_{15}^2 - 2D_5^2 = D_{25}^2 - D_5^2$

$\therefore D_{25}^2 = 2D_{15}^2 - D_5^2$

$\therefore D_{25} = \sqrt{2 \times 0.62^2 - (0.3)^2} = \sqrt{0.6788} = 0.8238\ cm$

2) $\tan\theta \approx \theta = \frac{3 \times 10^{-6}}{10 \times 10^{-2}} = 3 \times 10^{-5}\ rad$



$\therefore \beta = \frac{d}{2\mu\theta} = \frac{450 \times 10^{-9}}{2 \times 1 \times 3 \times 10^{-5}} = 75 \times 10^{-4}$

but $\beta = \frac{x}{n}$ where $x = 10cm$, n = number of fringes.

$\therefore n = \frac{10 \times 10^{-2}}{75 \times 10^{-4}} = 13.33 \approx 13$

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3) $\mu = \frac{\sin i}{\sin r}$

$r = \sin^{-1}\left(\frac{\sin i}{\mu}\right) = \sin^{-1}\left(\frac{\sin 30}{1.44}\right) = 20.32$

$\therefore \cos r = \cos(20.32^\circ) = 0.9378$

For 5th dark band

$2\mu t \cos r = 5\lambda$

$\therefore t = \frac{5 \times 5893 \times 10^{-10}}{2 \times 1.44 \times 0.9378} = 1.0884 \times 10^{-6}$

$= 10884 \text{ Å}$

4) For destructive interference,

$2\mu t = n\lambda$

$t = \frac{n\lambda}{2\mu} = \frac{6 \times 10^{-7}}{2 \times 10^{-5}}$

$t = 2 \times 10^{-7} = 200 \text{ nm}$

$2\mu t \cos = (\text{extra}) \frac{\lambda}{2}$

$\because n = 0,$

$2(1.5)t = \frac{\lambda}{2}$

$t = \frac{600 \times 10^{-9}}{6}$

$t = 100 \text{ nm}$

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6) $i = 35^\circ$, $t = 5000\,\text{Å}$, $\mu = 1.33$

$$\mu = \frac{\sin i}{\sin r}$$

$$r = \sin^{-1}\left(\frac{\sin i}{\mu}\right) = 25.48^\circ$$

$$\therefore \cos r = \cos(25.48) = 0.9$$

Now, for minima,

$$2\mu t \cos r = n\lambda$$

$$\therefore \lambda = \frac{2 \times 1.33 \times 5 \times 10^{-7} \times 0.9}{n}$$

$$\lambda = \frac{12000}{n}\ \text{Å}$$

$\therefore \lambda_1 = 12000\,\text{Å}$, $\lambda_2 \cong 6000\,\text{Å}$, $\lambda_3 \cong 4000\,\text{Å}$

7) $d_{10} = 2\,\text{mm}$, $n = 10$, $\lambda = 500\,\text{nm}$

$$d_n^2 = 4n\lambda R$$

$$R = \frac{d_n^2}{4n\lambda} = \frac{4 \times 10^{-6}}{4 \times 10 \times 500 \times 10^{-9}}$$

$$= 0.2$$

$$2t = \frac{d_n^2}{4R}$$

$$2t = \frac{4 \times 10^{-6}}{4 \times 0.2}$$

$$t = 2.5 \times 10^{-6}\,\text{m} = 2.5\,\mu\text{m}$$