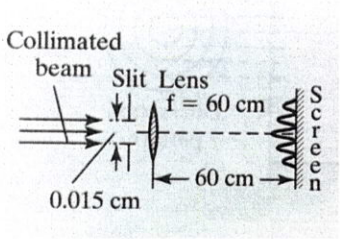
EC5103 May 10, 2017

Quiz#5

Name:

A collimated beam of mercury green light at 546.1 nm is normally incident on a slit 0.015 cm wide. A lens of focal length 60 cm is placed behind the slit. A diffraction pattern is formed on a screen placed in the focal plane of the lens. Determine the distance between (a) the central maximum and first minimum and (b) the first and second minima.



Sol) From the diffraction formula $I = I_0 \sin c^2(\beta)$,

$\beta = \frac{1}{2} k b \sin\theta = \pm\pi, \pm 2\pi, \ldots$ for minima: b is the slit width.
$m = \pm 1, 2, 3, \ldots$

$\rightarrow b \sin\theta = \frac{2\pi}{k} = \lambda$ for the first minima.

Here, $\theta \sim \sin\theta \sim \tan\theta = \frac{y_1}{f}$

(i) $\therefore y_1 = \frac{\lambda f}{b} = \frac{(5.461 \times 10^{-7})(0.6)}{1.5 \times 10^{-4}} = 2.184 (mm)$

(ii) $y_2 = \frac{2\lambda f}{b} = 2y_1$

The central maxima is at $y = 0$. $\rightarrow y_0$

(a) $y_1 - y_0 = 2.184$ mm

(b) $y_2 - y_1 = 2.184$ mm