Ch. 4 Prob. 23

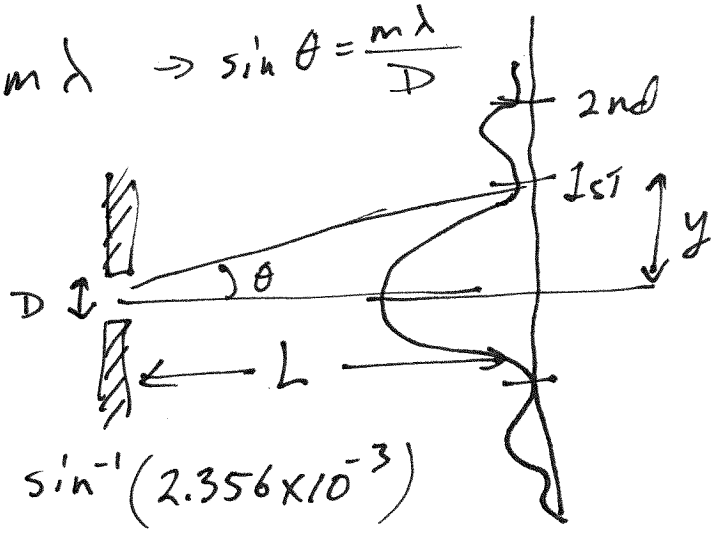
$\lambda = 589\,nm$

$L = 1.00\,m$

$D = 0.25\,mm$

Find the location of the 1st & 2nd dark fringe relative to the center of the pattern.

$D\sin\theta = m\lambda \rightarrow \sin\theta = \frac{m\lambda}{D}$



The first dark fringe is at angle

$\sin\theta_1 = \frac{\lambda}{D}$

$\theta_1 = \sin^{-1}\left(\frac{589\times10^{-9}\,m}{0.25\times10^{-3}\,m}\right) = \sin^{-1}(2.356\times10^{-3})$

$\theta_1 = 0.135°$

$\tan\theta_1 = \frac{y_1}{L} \rightarrow y_1 = L\cdot\tan\theta_1 = (1.00m)\tan(0.135°)$

$y_1 = 2.356\times10^{-3}\,m$

$y_1 = 2.36\,mm$

The second dark fringe is at angle

$\sin\theta_2 = \frac{2\lambda}{D}$

$\theta_2 = \sin^{-1}\left(\frac{2(589\times10^{-9}m)}{0.25\times10^{-3}\,m}\right) = \sin^{-1}(4.712\times10^{-3})$

$\theta_2 = 0.270°$

$\tan\theta_2 = \frac{y_2}{L} \rightarrow y_2 = L\tan\theta_2 = (1.00m)\tan(0.270°)$

$y_2 = 4.71\times10^{-3}\,m$

$y_2 = 4.71\,mm$