Assignment # 9

Optics III

Chapter 35: Interference

Important Formulas and Concepts

$d\sin\theta = m.\lambda$ (Constructive Interference)

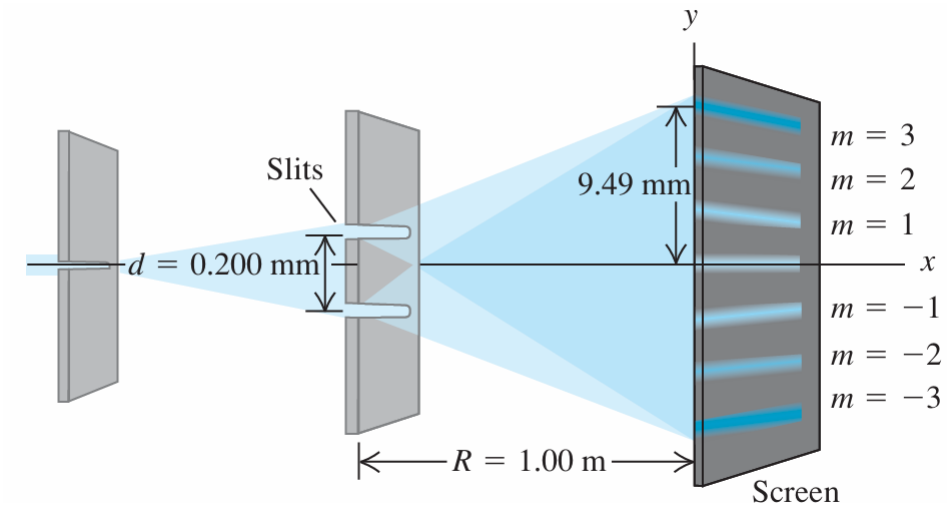
$y_m = R\frac{m\lambda}{d}$

$d\sin\theta = \left(m + \frac{1}{2}\right).\lambda$ (Destructive Interference)

$\emptyset = \frac{2\pi}{\lambda}(r_2 - r_1) = k.(r_2 - r_1)$ (phase difference related to path difference)

Question 1:

(a) The figure below shows a two-slit interference experiment in which the slits are 0.200 mm apart and the screen is 1.00 m from the slits. The m = 3 bright fringe in the figure is 9.49 mm from the central fringe. Find the wavelength of the light.



(b) Coherent light with wavelength 400 nm passes through two very narrow slits that are separated by 0.200 mm, and the interference pattern is observed on a screen 4.00 m from the slits. What is the width (in mm) of the central interference maximum? What is the width of the first-order bright fringe?

Question 2:

Two thin parallel slits that are 0.0116 mm apart are illuminated by a laser beam of wavelength 585 nm.

(a) On a very large distant screen, what is the total number of bright fringes (those indicating complete constructive interference), including the central fringe and those on both sides of

it? Solve this problem with out calculating all the angles! (Hint: What is the largest that $\sin\theta$ can be? What does this tell you is the largest value of m ?)

(b) At what angle, relative to the original direction of the beam, will the fringe that is most distant from the central bright fringe occur?

Question 3:

Coherent sources A and B emit electromagnetic waves with wavelength 2.00 cm. Point P is 4.86 m from A and 5.24 m from B. What is the phase difference at P between these two waves?

Question 4:

Coherent light of frequency $6.32 \times 10^{14}\ Hz$ passes through two thin slits and falls on a screen 85.0 cm away. You observe that the third bright fringe occurs at ±3.11 cm on either side of the central bright fringe.

(a) How far apart are the two slits?

(b) At what distance from the central bright fringe will the third dark fringe occur?

Question 5:

Consider two antennas separated by 9.00 m that radiate in phase at 120 MHz. A receiver placed 150 m from both antennas measures an intensity I_o. The receiver is moved so that it is 1.8 m closer to one antenna than to the other.

(a) What is the phase difference between the two radio waves produced by this path difference?

(b) In terms of I_o, what does the receiver measure the intensity at its new position?