Related Problem with Solution :

A beam of light consisting of two wavelengths, 650 nm and 520 nm, is used to obtain interference fringes in a Young's double-slit experiment.

(a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.

(b) What is the least distance from the central maximum where the bright fringes due to both the wavelengths coincide? Answer

Wavelength of the light beam, $\lambda_1 = 650$ nm

Wavelength of another light beam, $\lambda_2 = 520$ nm

Distance of the slits from the screen = D

Distance between the two slits = d

(a) Distance of the n^{th} bright fringe on the screen from the central maximum is given by the relation,

$$x = n\lambda_1\left(\frac{D}{d}\right)$$

For third bright fringe, $n = 3$

$$\therefore x = 3 \times 650\frac{D}{d} = 1950\left(\frac{D}{d}\right) \text{ nm}$$

(b) Let the n^{th} bright fringe due to wavelength λ_2 and $(n - 1)^{th}$ bright fringe due to

wavelength λ_1 coincide on the screen. We can equate the conditions for bright fringes as:

$$n\lambda_2 = (n-1)\lambda_1$$
$$520n = 650n - 650$$
$$650 = 130n$$
$$\therefore n = 5$$

Hence, the least distance from the central maximum can be obtained by the relation:

$$x = n\lambda_2\frac{D}{d}$$
$$= 5 \times 520\frac{D}{d} = 2600\frac{D}{d} \text{ nm}$$

Note: The value of d and D are not given in the question.