For Dark fringes :-

If the path difference is an odd number multiple of half wavelength, the point P is dark.

$$\frac{xd}{D} = (2n+1)\frac{\lambda}{2}$$

where $n = 0, 1, 2, 3, \ldots$

or, $$x = (2n+1)\frac{\lambda D}{2d} \quad \text{---(V)}$$

This equation gives the distances of the dark fringes (minima) from the point C.

When $n = 0$, then $x_0 = \frac{\lambda D}{2d}$

$n = 1$ then $x_1 = \frac{3\lambda D}{2d}$

$n = 2$ then $x_2 = \frac{5}{2}\frac{\lambda D}{d}$

and $x_n = \frac{(2n+1)\lambda D}{2d}$ ---

The distance between any two consecutive dark fringes

$$x_2 - x_1 = \frac{5}{2}\frac{\lambda D}{d} - \frac{3}{2}\frac{\lambda D}{d} = \frac{\lambda D}{d} \quad \text{---(VI)}$$

The distance between any two consecutive bright & dark fringes is called fringe width.

Date :

Therefore alternately bright and dark parallel fringes are formed. The fringes are formed on both sides of C. From eqn (V) & (VI) it is clear that the width of the bright fringes is equal to the width of the dark fringe. All the fringes are equal in width and are independent of the order of the fringe.

The breadth of a bright or a dark fringe is however, equal to half the fringe width and is equal to $\frac{\lambda D}{2d}$.

The fringe width $\beta = \frac{\lambda D}{d}$.

Thus we see that

(i) the width of the fringe is directly proportional to the wavelength of light

i.e $\beta \propto \lambda$.

(ii) the width of the fringe is directly proportional to the distance of the screen from the two sources,

i.e $\beta \propto D$.

(iii) the width of the fringe is inversely proportional to the distance between the two sources,

i.e $\beta \propto \frac{1}{d}$.

Teacher's Signature

Agewise. Thus the width of the fringe increases with the increase in wavelength, with increase in the distance D and by bringing the two sources A & B close to each other.

Example:- Green light of wavelength 5100 A^0 from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen 200 cm away is 2 cm. find the slit separation.

Solⁿ:- We know that

$$\beta = \frac{\lambda D}{d}$$

Given $\lambda = 5100 \times 10^{-8}$ cm

$D = 200$ cm

$10\beta = 2$ cm

or $\beta = 0.2$ cm

$d = ?$

or $d = \frac{\lambda D}{\beta} = \frac{5100 \times 10^{-8} \times 200}{0.2}$

$= 0.051$ cm

Ans.

Date :

Phase difference and path difference:

If the path difference between the two waves is λ the phase difference $= 2\pi$

Suppose, for a path diff x, the phase diff $= \delta$
for a path diff λ, the phase diff $= 2\pi$

$\therefore$ For a path diff x, the phase diff $= \frac{2\pi x}{\lambda}$

Phase diff, $\delta = \frac{2\pi x}{\lambda}$

$= \frac{2\pi}{\lambda} \times$ Path difference

Teacher's Signature