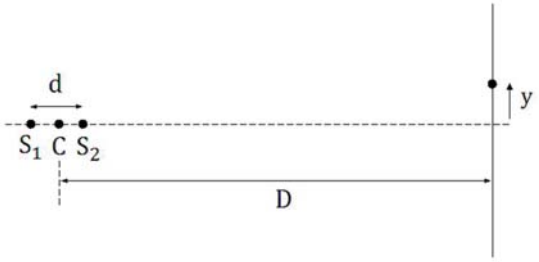
## CALCULATING MAXIMAS AND MINIMAS DUE TO INTERFERENCE OF TWO COHERENT SOURCES

### Maximas and minimas due to interference

We must determine the places where the light is brightest and darkest on the screen. Imagine there are two light sources, and the screen is positioned as illustrated in the diagram.




$\Delta x$ at point $C$ on screen: $\Delta x_c = d$

From figure,

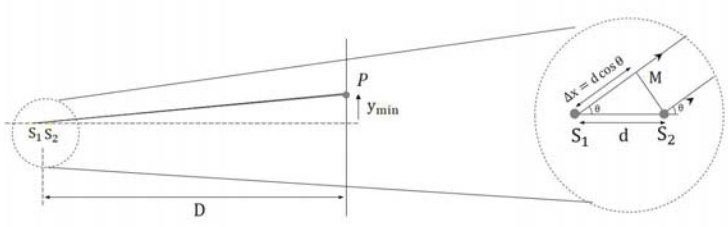
$$\Delta x \text{ at } P = S_1P - s_2P$$
$$= \sqrt{y^2 + (D + d/2)^2} - \sqrt{y^2 + (D - d/2)^2}$$

To locate the top and bottom points, we make a quadratic equation. Solving it gives us the value of y. This helps us find these points, though solving the equation might be hard. So, we'll use a simpler method with some assumptions instead.

$$\Delta x = \sqrt{y^2 + (D + \frac{d}{2})^2} - \sqrt{y^2 + (D - \frac{d}{2})^2}$$

Practically, $d \ll D$.

As the distance between sources is very small compared to their distance from screen, $S_1P$ and $S_2P$ can be assumed as parallel lines.




From triangle $S_1S_2M$, $\Delta x = d\cos\theta$

Also, $\tan\theta = \frac{y}{D} \Rightarrow \cos\theta = \frac{D}{\sqrt{D^2 + y^2}}$

$$\Delta x = \frac{dD}{\sqrt{\gamma^2 + D^2}}$$

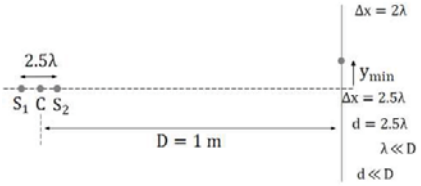
**Ex.** Find $y_{min}$ for first maxima in the situation shown. Given $\lambda \ll D$.

**Sol.** At the central position on screen, $\Delta x = 2.5\lambda$.

Thus, the first maxima closest to this point will happen at,

$\Delta x = 2\lambda$.

Thus, for first maxima




$$\Delta x = d\cos\theta = \frac{d-D}{\sqrt{y^2+D^2}} = 2\lambda$$
$$\frac{1}{\sqrt{y^2 + 1^2}} = \frac{4}{5}$$
$$\frac{25}{16} = y^2 + 1$$
$$2S = 16y^2 + 16$$
$$9 = 16y^2$$

$$y = \sqrt{\frac{9}{16}} = \frac{3}{4}\,m$$

$$y_{min} = 0.75\ m$$

**Young's double slit experiment**

Two synchronized light sources are created by dividing a single source with a sheet containing two small openings. These openings are similar in size to the wavelength of light. The pattern created by the interference of these dual slit-sources shows up on a screen. Because the sources are synchronized, we observe alternating bright and dark bands on the screen, symbolizing high and low points, respectively.