Huygens principle:

- Every point on a given wave front (called the primary wave front) acts as a fresh source of new disturbances, called secondary wavelets.
- The surface touching these secondary wavelets tangentially in the forward direction at any instant, gives the new wave front at that instant. This is called secondary wave front.

Superposition principle:

When two or more wave motions travelling through a medium superimpose one another, a new wave is formed in which the resultant displacement $\vec{y}$ at any instant is equal to the vector sum of the displacements due to the individual waves $\overrightarrow{y_1}, \overrightarrow{y_2}$ at that instant, i.e., $\vec{y} = \overrightarrow{y_1} + \overrightarrow{y_2} + \overrightarrow{y_3} + \overrightarrow{y_4} + ...$

Coherent sources:

- Conditions →
  - Coherent sources of light should be obtained from a single source by some device.
  - The two sources should give monochromatic light.
  - The path difference between the light waves from two sources should be small.

Interference of light:

Interference of light is the phenomenon of redistribution of light energy in a medium on account of the superposition of light waves from two coherent sources.

Intensity of the resultant wave:

$I \propto a^2 + b^2 + 2ab\cos\phi$

- For constructive interference,

I should be maximum, for which

$\boxed{\phi = 2n\pi}$

Where, $n = 0, 1, 2 \ldots$

ϕ = Constant phase angle by which the second wave leads the first wave

If x is the path difference between the two waves, corresponding to phase difference ϕ, then

$\boxed{x = n\lambda}$

- For destructive interference,

I should be minimum

$\cos\phi$ = Minimum $= -1$

$\therefore \boxed{\phi = (2n-1)\pi}$

Where, $n = 1, 2 \ldots$

The corresponding path difference between the two waves:

$$\boxed{x = \ 2n-1 \ \frac{\lambda}{2}}$$

Fringe width:

- For bright fringes (maxima),

  $$\boxed{x = n\lambda \frac{D}{d}}$$

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

- For dark fringes (minima),

  $$\boxed{x = \ 2n-1 \ \frac{\lambda}{2}\frac{D}{d}}$$

  Where,

  D = Distance of the screen from the slits

  d = Distance between the two slits

Fringe width $\beta = \frac{\lambda D}{d}$ (all bright and dark fringes are of equal width)

Note: Angular separation of the fringes is just $\left(\frac{\lambda}{d}\right)$. It is independent of the position of the screen.

Diffraction of light:

A single slit of width 'a' gives a diffraction pattern with a central maximum. The intensity falls to zero at angles of $\pm\frac{\lambda}{a}, \pm\frac{2\lambda}{a}$, etc., with successively weaker secondary maxima in between.

- Diffraction limits the angular resolution of a telescope to $\frac{\lambda}{d}$, where D is the diameter. Two stars closer than this give strongly overlapping images. Similarly, a microscope objective subtending angle 2β at the focus, in a medium of refractive index n, will just separate two objects spaced at a distance $\frac{\lambda}{2n\sin\beta}$, which is the resolution limit of a microscope.
- A beam of width a travels a distance $\frac{a^2}{\lambda}$ (called the Fresnel distance), before it starts to spread out due to diffraction.

Polarisation of light:

The phenomenon of restriction of the vibration of light (electric vector) in a particular direction, perpendicular to the direction of wave motion, is called polarisation of light. The tourmaline crystal acts as a polariser.

- Nicol prism → An optical device used for producing plane polarised light and analysing the same
- Poloroids → A polaroid is a material which polarises light. It transmits only one component (parallel to special axis). The resulting light is called linearly polarised or plane polarised. When this kind of light is viewed through a second polaroid whose axis turns through 2π, two maxima and minima of intensity are seen. Polarised light can also be produced by reflection at a special angle (called the Brewster angle), and by scattering through $\frac{\pi}{2}$ in the earth's atmosphere.