

TOPIC - Superposition of waves

If two or more travelling waves are moving through a medium, the resultant value of the wave function at any point is the algebraic sum of the value of the individual waves.

The principle of superposition is the most important principle in wave optics. It also applies to electromagnetic wave. In EM waves, the term displacement refers to the amplitude of electric field vectors.

Interference is an important consequence of superposition of coherent waves.

Linear waves - waves that obey this principle are called linear waves

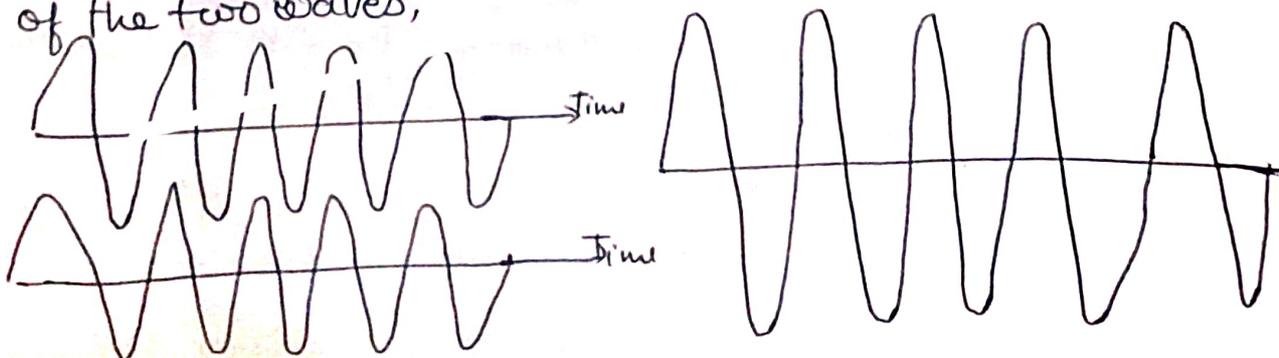
Non-linear waves - waves that do not obey this principle are called non linear waves

INTERFERENCE :-

If two or more light waves of same frequency overlap at a point, the resultant effects depends on the phase of waves and their amplitude. The resultant waves at any point at any instant of time is governed by the principle of superposition.

Let us assume here that the component waves are of the same amplitude.

At certain points, the two waves may be in phase. The amplitude of the resultant waves is the sum of the amplitude of the two waves,



Thus, the amplitude of the resultant waves

$$E_R = E + E = 2E$$

Hence, the intensity of the resultant waves

$$I_R \propto E_R^2 = 2E^2 = 2^2 I = 4I$$

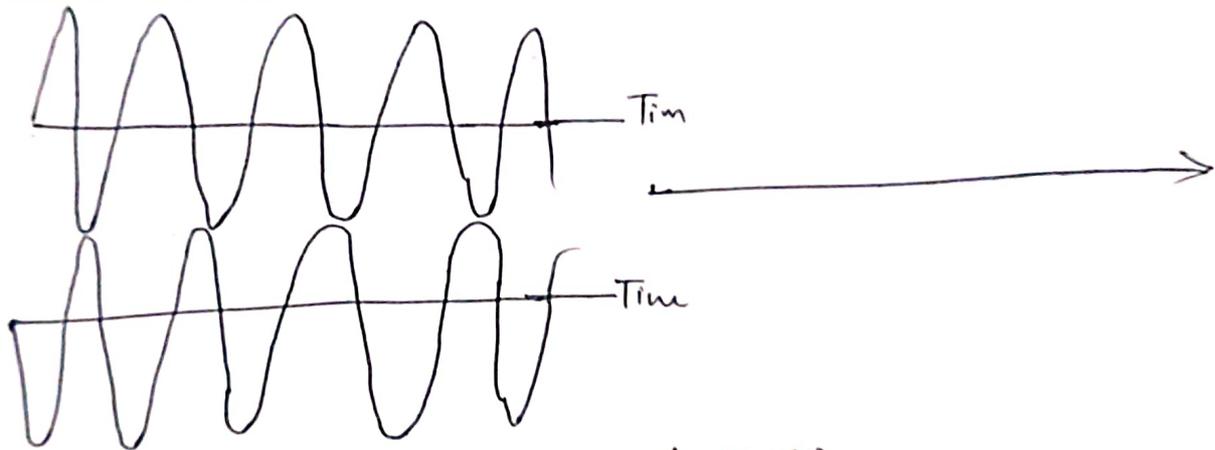
It is obvious that $I_R = \text{Resultant Intensity}$

$$I_R > I + I = 2I$$

Resultant Intensity $>$ the sum of intensities due to individual waves.

Therefore, the interference produced at these points is known as constructive interference. A stationary bright band of light is observed at point constructive interference.

x x If two waves may be in opposite phase:



Thus the amplitude of resultant waves

$$E_R = E - E = 0$$

Hence the resultant of intensities waves

$$I_R \propto 0^2 = 0$$

It is obvious that

$$I_R < 2I$$

Resultant intensity $<$ the sum of intensities due to individual waves.

$$I_R < 2I$$

Therefore, interference produced at these points is called destructive interference. At these point, a stationary dark band of light is observed.

