INTERFERENCE

B.Sc. II (paper-1)

Unit-I

Dr. A.K. DWIVEDI

DEPARTMENT OF PHYSICS
HARISH CHANDRA P. G. COLLEGE VARANASI

SUPERPOSITION WAVE

Two waves traveling in opposite directions across the same medium combine linearly. In this animation, both waves have the same wavelength and the sum of amplitudes results in a standing wave.

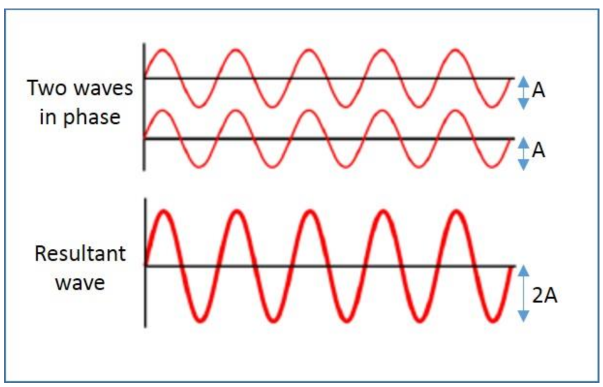
Waves are usually described by variations in some parameter through space and time—for example, height in a water wave, pressure in a sound wave, or the electromagnetic field in a light wave. The value of this parameter is called the amplitude of the wave, and the wave itself is a function specifying the amplitude at each point.

In any system with waves, the waveform at a given time is a function of the sources (i.e., external forces, if any, that create or affect the wave) and initial conditions of the system. In many cases (for example, in the classic wave equation), the equation describing the wave is linear. When this is true, the superposition principle can be applied. That means that the net amplitude caused by two or more waves traversing the same space is the sum of the amplitudes that would have been produced by the individual waves separately. For example, two waves traveling towards each other will pass right through each other without any distortion on the other side. (See image at top.)

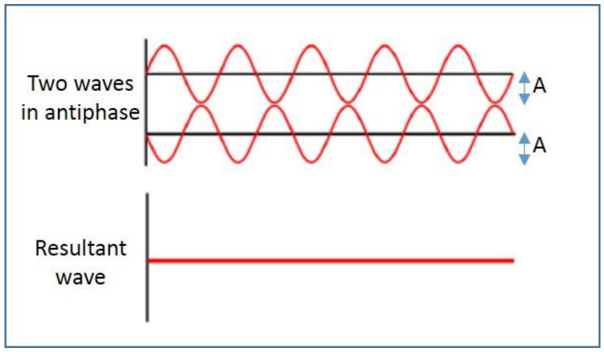
- The **principle of superposition** states that when two or more waves meet at a point, the resultant displacement at that point is equal to the sum of the displacements of the individual waves at that point.

- If the two incoming waves that are in **phase** have amplitude of A, then the resultant wave has an amplitude of 2A

.



- If the two incoming waves that are in **antiphase** have amplitude of A, then the resultant wave has an amplitude of zer



Stationary waves are formed by two waves with the same frequency travelling in opposite directions.

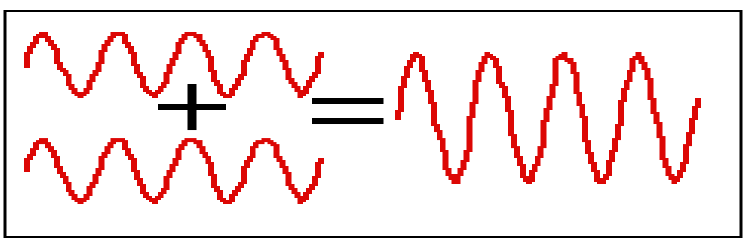
INTERFERENCE DEFINITION

Interference of light is defined as: "When two or more light waves having the same frequency, same wavelength and same amplitude meet together in a medium at a point, they cancel or enhance the effect of each other at that point. This phenomenon is called interference of light waves."There are two types of interference of light:

- Constructive interference
- Destructive interference

CONSTRUCTIVE INTERFERENCE DEFINITION

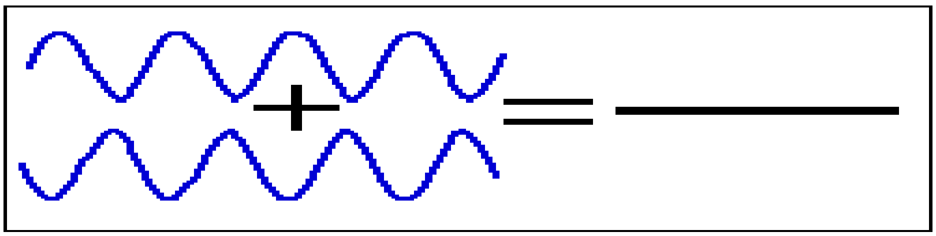
When two light waves superpose with each other in such a way that the crest of one wave falls on the crest of the second wave, and the trough of one wave falls on the trough of the second wave, then the resultant wave has larger amplitude and intensity. Such type of interference is called constructive interference. Some of its effects are:



Constructive Interference

- In constructive interference, two waves of light reinforce each other.
- In constructive interference, a bright fringe is obtained on the screen.

In **destructive interference** When two light waves superpose with each other in such a way that the crest of one wave coincides with the trough of the second wave, then the amplitude and intensity of resultant wave become zero.



Destructive Interference

Some of its effects are:

- Two waves cancel the effects of each other.
- Due to a dark fringe is obtained on the screen.

CONDITIONS FOR INTERFERENCE

In order to observe the interference of light waves, following conditions must be met.

- The two light sources must be coherent, that is, they must maintain a constant phase with respect to each other.
- The two light sources should be monochromatic, that is, of a single wavelength.
- The principle of superposition must apply.

References Books

1. A textbook of opics by **Brij Lal And Subramaniam.**
2. Optics by **Ajay Ghatak.**
3. Physical optics and lasers by **J.P Agrawal.**