

INTERFERENCE OF LIGHT

Definition:

The phenomenon of redistribution of energy in the resultant light wave formed by superposition of two light waves having same frequency and same amplitude **is called as interference of light.**

- Interference phenomenon can also be observed in sound wave.
- In interference, energy is redistributed but total energy remains the same. Hence, interference is in accordance to principle of conservation of energy.

In some regions, energy disappears completely (appears dark) and in other region energy appears (appears bright). The energy lost in dark regions reappears in bright region such that the total energy remains constant.

Coherent Sources:

Two sources of light emitting light of same frequency, same amplitude and having zero or constant phase difference **are called as coherent sources.**

➤ Two independent electric bulbs (or candles) of same power emitting same wavelength cannot produce coherent light **because they may not have constant phase difference.** [Although they appear identical in all respects, they are not coherent sources].

Only coherent sources can produce sustained (permanent) interference.

- ❖ Coherent sources are those
 - a. whose wavelength is same
 - b. whose amplitude is same
 - c. whose frequency is same
 - d. which maintain a constant phase difference

Conditions for sustained (continuous) interference:

1. The two sources must be coherent.
2. The waves should have a certain path difference.
3. The waves should have equal (or nearly equal) amplitude.
4. The two sources must lie close to each other.
5. The distance of the source and screen should be large.
6. Two sources should be narrow.

Types of interference:

There are two types of interference:

1. Constructive interference:

The interference in which the energy (or intensity or amplitude) of light become maximum is called as constructive interference.

- Constructive interference occurs when two light waves superimpose in same phase.

$$[\text{Phase difference} = 0, 2\pi, 4\pi, 6\pi \dots \dots \quad \{2n\pi ; n = 0, 1, 2, \dots\}] \quad \text{Even } \pi$$

$$\text{And } [\text{Path difference} = 0, \lambda, 2\lambda, 3\lambda, \dots \dots \quad \{n\lambda ; n = 0, 1, 2, \dots\}]$$

Constructive interference occurs when two waves superimpose in such a way that **crest meets crest and trough meets trough.**

- At constructive interference: amplitude: $A = A_{max} = A_1 + A_2$
and intensity: $I = I_{max} = I_1 + I_2 + 2\sqrt{I_1 I_2}$

2. Destructive interference:

The interference in which the energy (or intensity or amplitude) of light become minimum (zero) is called as destructive interference.