Contents

Introduction

The beautiful colour seen in the film of oil on the road or a soap bubble, are due to a phenomenon of light called interference. Other example like coloured Newton's Rings.

A single source of light emits light which spreads uniformly in all direction, but when there are two sources of light, giving out light waves of equal amplitude and wavelength, the light energy at all point is not uniform it is maximum at a certain points and minimum at other points.

This redistribution of light energy due to superposition of two light waves is called interference.

Type of Interference :

Constructive Interference:

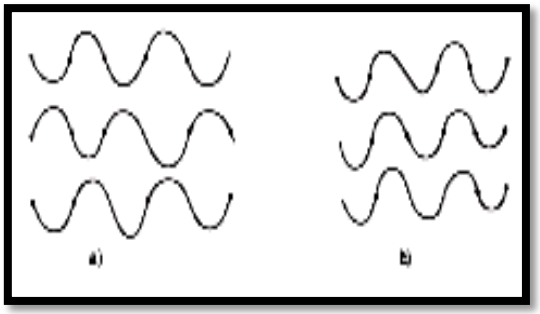
when crest of one wave falls on the crest of another wave and trough of one wave falls on trough of another wave is called constructive interference which results maximum intensity.

Distractive Interference:

when crest of one wave falls on the trough of another wave and trough of one wave falls on crest of another wave is called distractive interference which results minimum intensity.

Phase Difference

Phase Difference:
Two waves that have the same frequencies and different phases are known to have a phase difference .



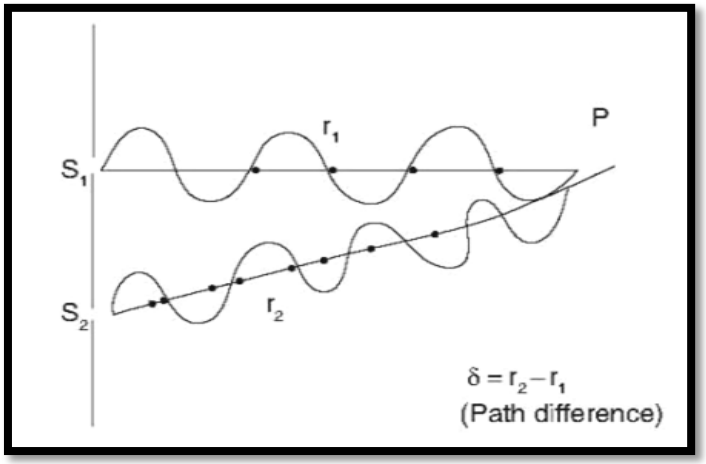
If the phase difference is 180^0 then the two waves are said to be in anti-phase and if it is 0^0,then they are in phase

If the two interfering waves meet at a point where they are in anti-phase, then the destructive interference occur.

If the two interfering waves meet at a point where they are in phase, then the constructive interference occur.

Path Difference

When crests of two wave traveling a different distance from their source, they meet at a point a P in such a that a crests meets a crests. For this particular location on the pattern, the difference in distance travelled is known as path difference.



Relation between path difference and Phase Difference

It is clear from the positions of crests or trough of the waves that if the path difference between the two waves is equal to the wavelength λ. The corresponding phase difference is 2π. Suppose for a path difference of δ the corresponding phase difference is ϕ.

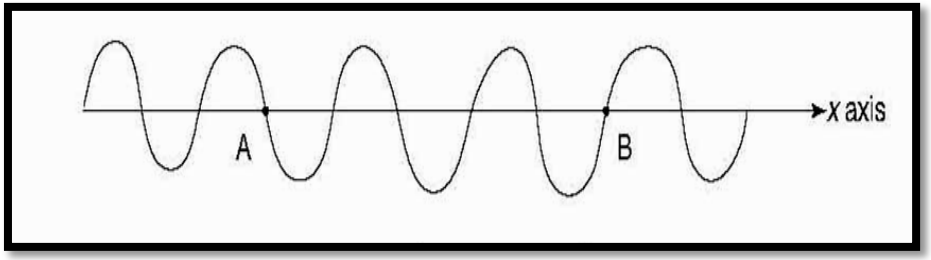
Phase difference = $\frac{2\pi}{\lambda}$ x Path difference

$\Phi = \frac{2\pi}{\lambda} \times \delta$

Coherence

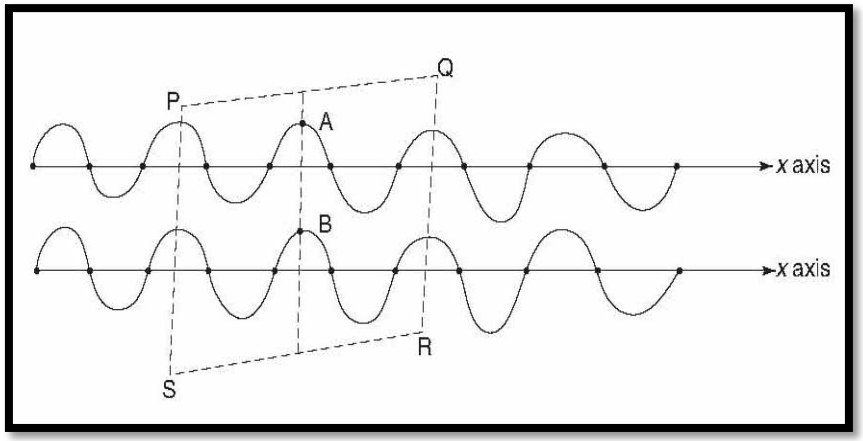
Two waves are said to be coherent if they have a constant relative phase. This means that they have same frequency. Thus the coherence is a measure of the correlation that exist between the phase of the wave measured at different points. The coherence of a wave depends on the characteristics of its source.

Temporal Coherence: Temporal Coherence is a measure of the correlation between the phase of a wave at different points along the direction of wave propagation. If the phase difference of the wave crossing the two points lying along the direction of wave propagation is independent of time, then the wave is said to have temporal coherence.



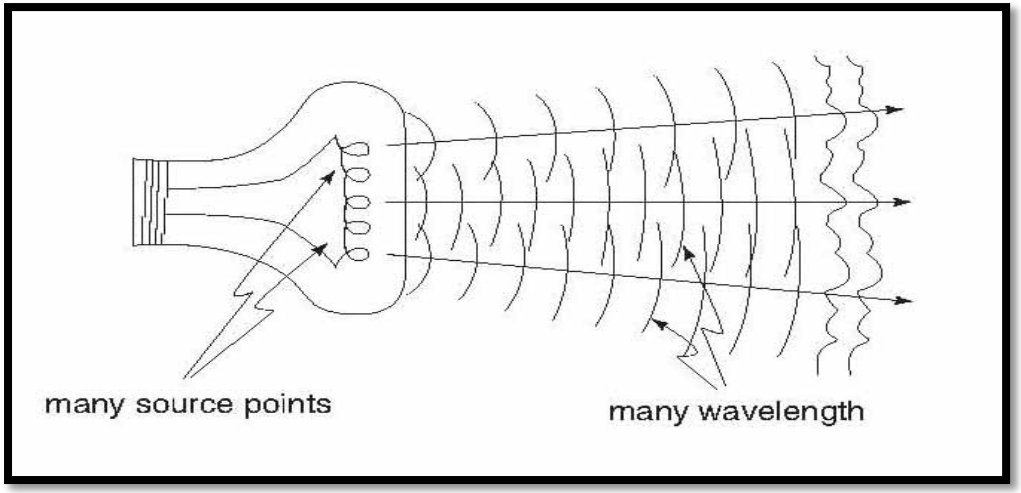
Spatial Coherence

Spatial Coherence: Spatial coherence is a measure of the correlation between the phase of a wave at different points transverse to the direction of wave propagation. If the phase difference of the wave crossing the two points lying on a plane perpendicular to the direction of wave propagation is independent of time, then the wave is said to have Spatial coherence.



Coherent sources

Coherent sources: **Two source are said to be coherent if they emit waves of the same frequency, nearly the same amplitude and maintain a constant phase difference between them . Laser is a good example of coherent source.**



Condition for sustained interference

- **In order to obtain sustained interference the following condition must be satisfied**
- **The two sources should emit waves of the same frequency(wavelength). If it is not so, then the position of maxima and minima will change with time.**
- **The waves from the two sources should propagate along the same direction with equal speeds.**
- **The phase difference between the two interfering waves should be zero or it should remain constant. It means the sources emitting these waves must be coherent.**
- **In order to obtain distinct and clear maxima and minima, the amplitudes of the two interfering waves must be equal or nearly equal.**
- **In order to obtain the pattern with constant fringe width and good intensity fringes the sources should be monochromatic and the background should be dark.**
- **The two coherent sources should be very close to each other.**