Quadrant II – Transcript and Related Materials

Programme : Bachelor of Science (Second Year)

Subject : Physics

Semester : IV

Paper Code : PYC 104

Paper Title : Section I-Optics

Name of the Unit : Interference

Module Name : Introduction - Interference by division of wavefront and division of amplitude

Module No : 01

Name of the Presenter: Mahendra R. pednekar, Associate Professor,

Government College of Arts, Science and Commerce Sanquelim Goa

---

Notes :

Introduction

When light waves from two sources cross each other's path there is a modification of intensity of light in the region of crossing. This modification of intensity of light is called interference of light.

According to the principle of superposition, the resultant displacement at any point and at any instant is obtained by vectorially adding the instantaneous displacements that would be produced at that point by each individual wave.

Requirements for good interference pattern.

Monochromatic source.

Coherent sources : Sources which have

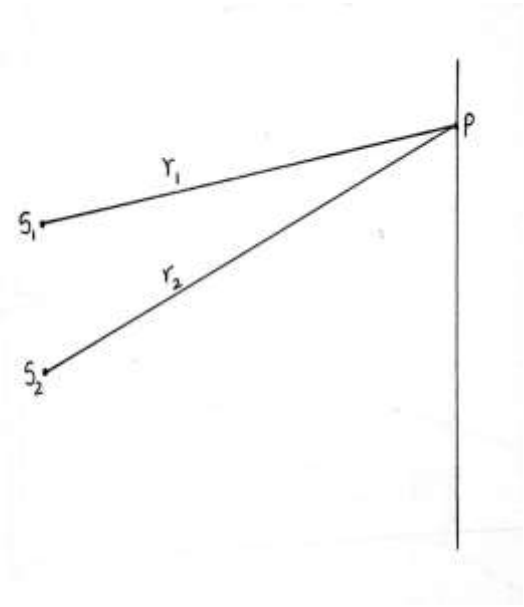
(i) point to point correspondence between them.

(ii) and in which a change in phase of vibration of one produces a corresponding and simultaneous change in the phase of the other.

Amplitude of interfering waves must be preferably equal.

At points in the path of wave motion, where the two waves meet exactly in phase i.e. crest of one falls on the crest of the other or trough of one falls on the trough of the other, there is reinforcement thereby producing more brightness than what would be produced by one wave alone.

At points where two waves meet out of phase i.e. crest of one falls on trough of the other, there is destructive interference and hence complete darkness.



Here S_1 and S_2 are two coherent sources. Light from these sources travel along different paths S_1P and S_2P and meet at P due to superposition.

If path difference between them is equal to zero or an integral multiple of wavelength λ, then the waves arrive in phase at P and produces constructive interference or brightness. i.e. $S_1P - S_2P = m\lambda$

Where m is an integer . m = 0,1,2,3,…….

On the other hand, if the path difference is equal to an odd integral multiple of $\frac{\lambda}{2}$, the waves arrive out of phase at P and produces destructive interference or darkness.

i.e. $S_1P - S_2P = (2m + 1) \frac{\lambda}{2}$

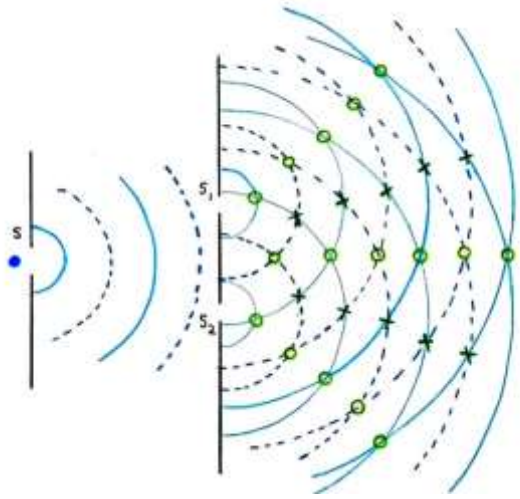
Here m is an integer and takes values,

m = 0,1,2,3, …….

There are mainly two methods of obtaining coherent sources to produc interference effect.

- Division of Wavefront
- Division of amplitude

Division of Wavefront



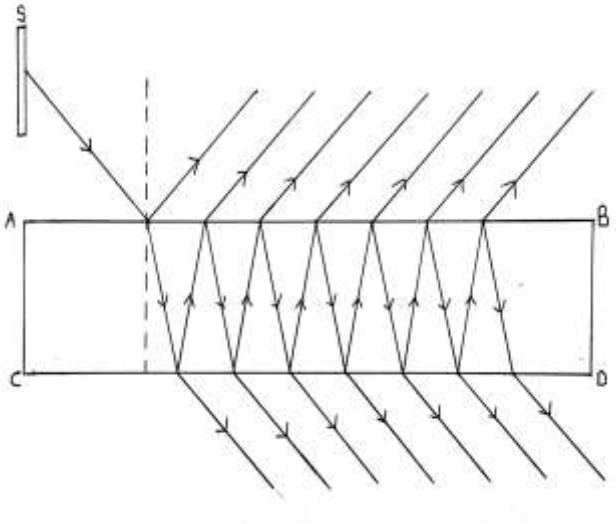
S is source of monochromatic light emitting light waves in all directions. S_1 and S_2 are two slits illuminated by parent source S. The two slits become two coherent sources .The secondary wavefronts originating from S_1 and S_2 interfere with each other at various points giving rise to the phenomenon of interference. This method of producing an interference effect is called division of wavefront.

Devices in which coherent sources are obtained by division of wavefront method are

Fresnel biprism

Lloyd's mirror

Division of Amplitude



When a ray of monochromatic light is incident on a thin plane transparent medium, it is partially reflected and partially refracted. The partially refracted ray of light is further split up into a number of reflected and refracted rays after successive reflections and refractions from the two surfaces of separation The partially reflected rays emerging out of the surface AB interfere with each other at various points and produce interference effect. Similarly the transmitted light emerging from CD can also produce interference effect in the same manner, This method by which an interference effect is produced due to the recombination of a number of beams of light obtained due to the partial reflections and partial refractions, is known as division of amplitude Here we have seen that the intensity of incident light is divided by partial reflections and refractions and also since the division of intensity is due to the division of amplitude, this method is known as **division of amplitude.**