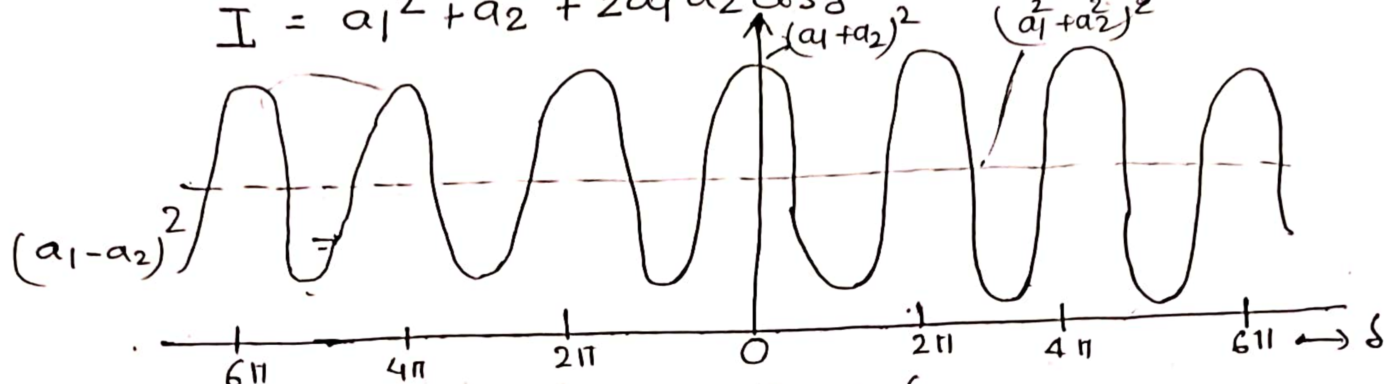
UNIT-1
OPTICS

B·SC Sem-IV
2023-27

TOPIC — Distribution of Energy / Conditions for interference

The resultant intensity of light at any point in the interference pattern is given by

$$I = a_1^2 + a_2^2 + 2a_1a_2\cos\delta$$



Graph between I and δ

Perodic curve with highest and lowest points at $(a_1+a_2)^2$ and $(a_1-a_2)^2$ respectively, which are max^m and min^n Intensities.

Average intensity between the range δ = 0 to δ = 2π is given,

$$I_{av} = \frac{\int_0^{2\pi} I \, d\delta}{\int_0^{2\pi} d\delta} = \int_0^{2\pi} (a_1^2 + a_2^2 + 2a_1a_2\cos\delta)\, d\delta$$

$$= \left[a_1^2\delta + a_2^2\delta + 2a_1a_2\sin\delta\right]_0^{2\pi}$$

$$= \frac{2\pi(a_1^2 + a_2^2)}{2\pi}$$

$$\therefore I_{av} = a_1^2 + a_2^2$$

Thus average velocity is equal to the sum of the seperate intensities.

That is energy appearently disappears at min^m. is actually present at the max^m. Thus no violation of the law of conservation of energy in the interference phenomenon.

Conditions of interference

Intensity at points corresponding to Constructive and destructive interference must be maintained max^m. to zero

Now Condition for interference

(i) The two interferring beams should be coherent. That is the phase difference between them must remain constant with time.

The resultant intensity at a point.

$$I = a_1^2 + a_2^2 + 2a_1a_2\cos\delta$$

∴ I will remain constant if δ remains as constant.

(II) The two beams should have the same frequency. If the light are of diff. frequencies, the phase between them will continuously vary. The resultant intensity at a point will change with time.

(III) If the interferring waves are polarised, they must be in the same state.

(IV) The amplitude of the interferring waves should be equal.

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