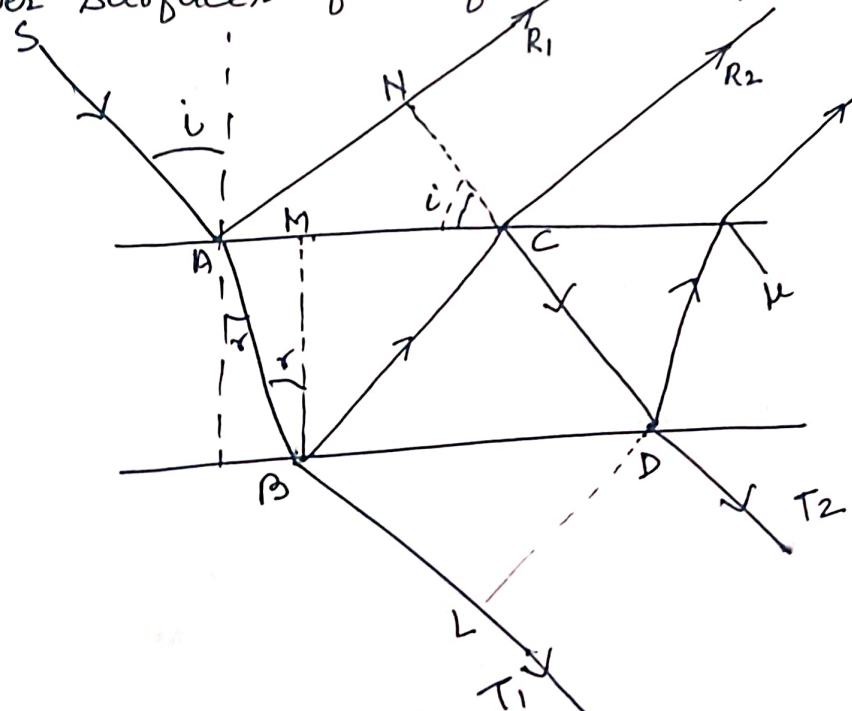


TITLE : - TWO beam Interference by division of Amplitude

Interference by thin film :-

When a film of oil spread over surface of water viewed by white light reflected from it, brilliant colours are often seen. A similar colour phenomenon is obtained from the bubble or from the thin glass plates. These colours arise due to interference between the light waves reflected from the upper and lower surfaces of the film or the plate.



Interference of light by parallel sides thin film

Let a parallel sides thin film of reflective index μ and thickness t be considered within an angle i on parallel-sided transparent thin film of thickness t refractive index $\mu > 1$

At A is ^{reflected} partly along AR₁ and partly along AB at angle σ .

SA $\rightarrow$ A beam of light of amplitude 'a' incident on the upper surface of the film.

AR₁ $\rightarrow$ Light reflected from the upper surface of the film.

AB = Light transmitted into the film through the upper surface.

BC = Light reflected from the lower surface of the film.

BT₁ = Light transmitted outside the film through the lower surface.

CR₂ = Light transmitted outside the film through the upper surface.

CD = Light re-reflected into the film at the point C.

The reflection coefficient of the film surfaces being high it can be assumed that the amplitude becomes insignificant after two reflections and hence subsequent reflections inside the film can be ignored.

NC and DL are perpendicular drawn from C and D

BM is the perpendicular drawn from C on BD.

Δ = path ABC in film path AN in air.

$$= \mu(AB + BC) - AN \quad \text{--- (1)}$$

$$\text{Now } AB = BC = \frac{BM}{\cos \sigma} = \frac{t}{\cos \sigma}$$

$$\text{and } AN = AC \sin \sigma$$

$$= (AM + MC) \sin \sigma$$

$$= (BM \tan \sigma + BM \tan \sigma) \sin \sigma$$

$$= 2\sigma \tan \sigma \sin \sigma$$

$$= 2t \frac{\sin \sigma}{\cos \sigma} (\sin \sigma) = 2t \frac{\sin \sigma}{\cos \sigma} (\mu \sin \sigma) \quad [\sin \sigma = \mu \sin \sigma]$$

$$= 2\mu t \frac{\sin^2 \sigma}{\cos \sigma}$$

Substituting the value of AB, BC and AN in (1)

$$\Delta = \mu \left(\frac{t}{\cos \sigma} + \frac{t}{\cos \sigma} \right) - 2\mu t \frac{\sin^2 \sigma}{\cos \sigma} = \frac{2\mu t}{\cos \sigma} (1 - \sin^2 \sigma) = 2\mu t \cos \sigma$$

The ray AR₁ having suffered a reflection at the surface of the denser medium undergoes a phase change of π which is equivalent to path difference $\lambda/2$.

Effective path diff bet AR₁ and CR₂ is $2\mu t \cos \sigma - \lambda/2$