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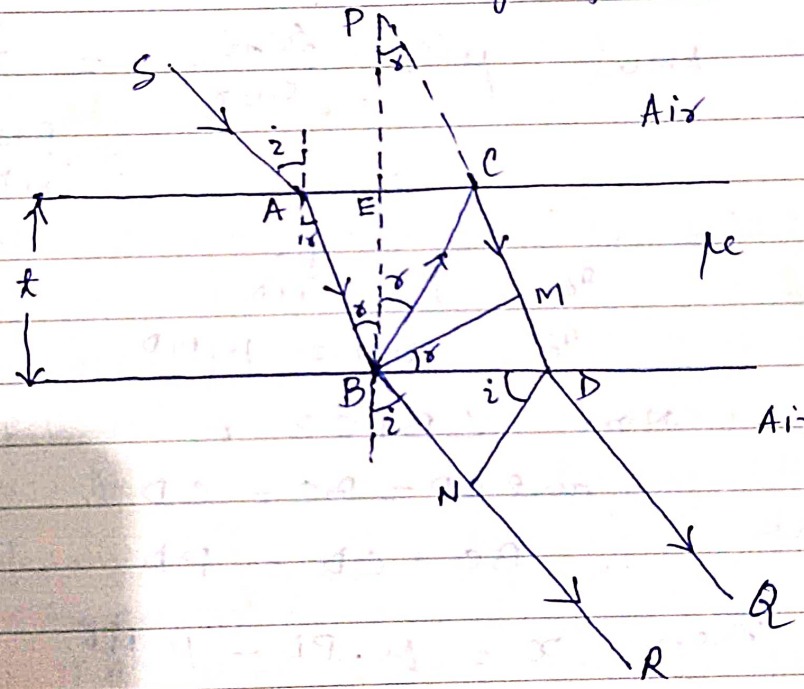
Interference in Transmitted light :— (Thin film)

Let, t = thickness of a thin transparent film

μ = Refractive index of material of thin film.

i = angle of incidence

and r = angle of refraction



Suppose a ray SA after refraction goes along AB. At B it is partly reflected along BC and partly refracted along BR. The ray BC after reflection at C, finally emerges along DQ.

Here at B and C reflection takes

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place at the rare medium (medium-air interface). Therefore no phase change occurs.

Now draw $BM \perp^r CD$

and $DN \perp^r BR$

The optical path difference between DQ and BR is given by,

$$x = \mu(BC + CD) - BN$$

Also $\mu = \frac{\sin i}{\sin r} = \frac{BN}{BD} \Big/ \frac{MD}{BD} = \frac{BN}{BD} \times \frac{BD}{MD}$

$$= \frac{BN}{MD}$$

In $\triangle BDN$: $\sin i = \frac{BN}{BD}$

In $\triangle MBD$: $\sin r = \frac{MD}{BD}$

(or) $\mu = \frac{BN}{MD}$

(or) $BN = \mu \cdot MD$

Now $\angle BPC = r$

and $CP = BC = CD$

$\therefore BC + CD = PD$

then $x = \mu \cdot PD - \mu MD$

$= \mu(PD - MD)$

$= \mu PM$

Now in $\triangle BPM$,

$$\cos r = \frac{PM}{BP}$$

(or) $PM = BP \cos r$

But $BP = BE + EP$

Here $BE = EP =$

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$\therefore BE = t$

$\therefore BP = t + t = 2t$

Now,

$PM = 2t \cos r$

$\therefore x = \mu\, 2t \cos r$ — (1)

For bright fringes, the path difference $x = n\lambda$

$\therefore 2\mu t \cos r = n\lambda$

Where $n = 0, 1, 2, 3 \ldots$

For dark fringes, the path difference $x = (2n+1)\lambda/2$

$\therefore 2\mu t \cos r = (2n+1)\lambda/2$

Where $n = 0, 1, 2, 3 \ldots$

In the case of transmitted light, the interference fringes obtained are less distinct because the difference in amplitude between BR and DQ is very large.

However, when the angle of incidence is nearly 45°, the fringes are more distinct.

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