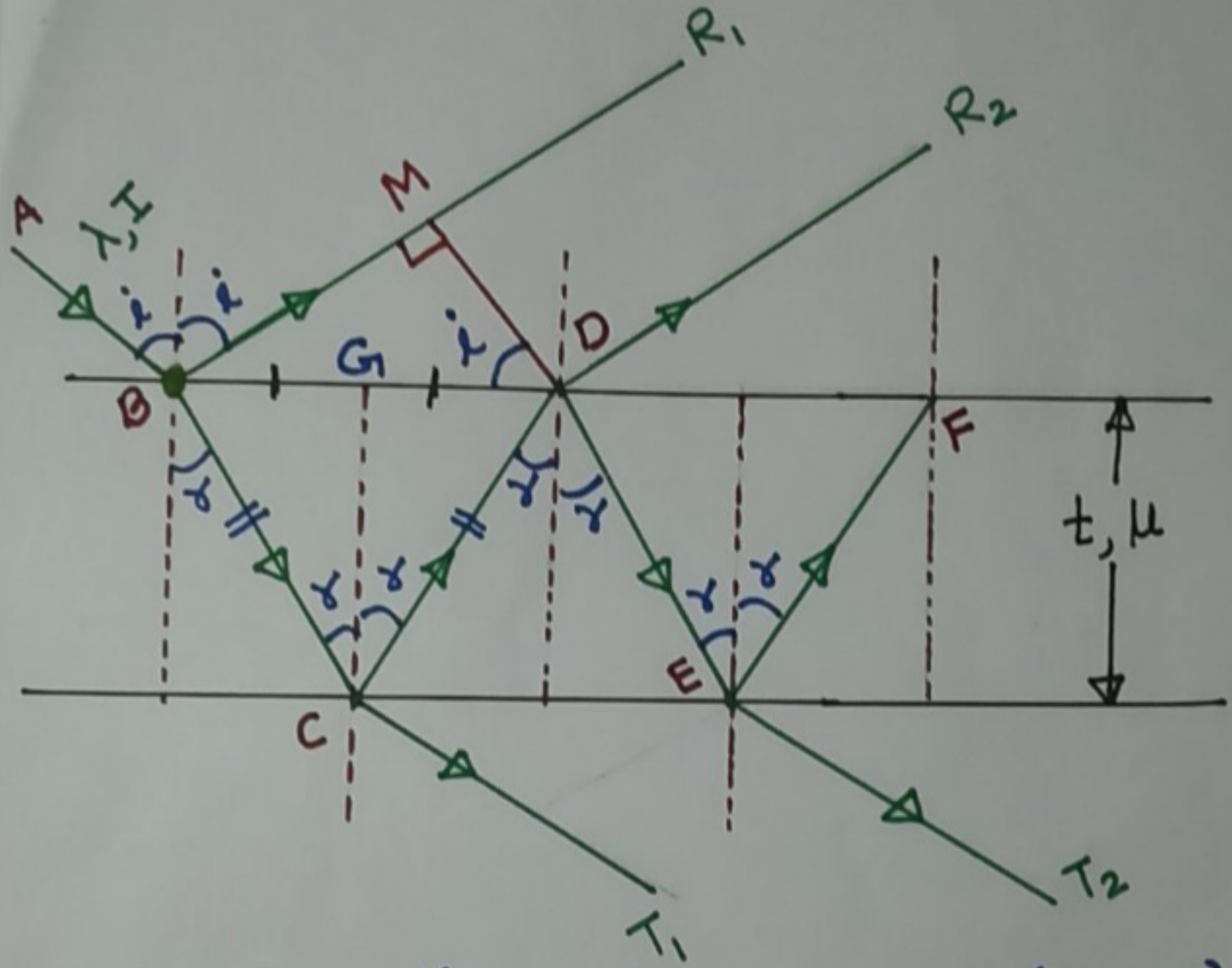
Interference in thin film of Uniform thickness

(A) Reflected System:-



BCD in medium of RI $\mu \Rightarrow \mu(BC+CD)$

BM in air $\Longrightarrow$ BM

$\therefore$ O.P.d $= \mu(BC+CD) - BM \longrightarrow (1)$

$\because BC = CD$

$2(BC)$

$\therefore$ OPd $= 2\mu(BC) - (BM) \longrightarrow (2)$

$$opd = 2\mu(BC) - BM \longrightarrow (2)$$

$$\cos r = \frac{CG}{BC} = \frac{t}{BC}$$

$$\therefore BC = (t)/(\cos r) \longrightarrow (3)$$

$$\sin i = \frac{BM}{BD} = \frac{BM}{BG + GD} = \frac{BM}{2(BG)}$$

$$\because BG = GD$$

$$\therefore BM = 2(BG)\sin i \longrightarrow (4)$$

$$\tan r = \frac{BG}{CG} = \frac{BG}{t} \Rightarrow BG = t\tan r \longrightarrow (5)$$

(5) → (4)

$$BM = (2)(t)(\tan r)(\sin i) \longrightarrow (6)$$

(3), (6) → (2)

$$opd = 2\mu\left(\frac{t}{\cos r}\right) - 2t(\tan r)(\sin i)$$

$$opd = \frac{2\mu t}{\cos r} - 2t\left(\frac{\sin r}{\cos r}\right)(\sin i)\,\frac{\sin r}{\sin r} \rightarrow \mu$$

$$opd = \frac{2\mu t}{\cos r}(1 - \sin^2 r) \rightarrow \cos^2 r$$

$$opd = 2\mu t\cos r \longrightarrow (7)$$

opd = $2\mu t \cos r$ ⟶ (7)

Reflection at B ⇒ at surface of denser (path changes by $\lambda/2$)

Reflection at C ⇒ at surface of rarer (no path changes)

∴ additional path changes by $(\lambda/2)$

∴ effective opd

$$\boxed{\delta = 2\mu t \cos r \pm \frac{\lambda}{2}} \longrightarrow (8)$$

① Condition for max / bright

$$\delta = n\lambda$$

$$\therefore 2\mu t \cos r \pm \frac{\lambda}{2} = n\lambda$$

$$2\mu t \cos r = n\lambda \mp \frac{\lambda}{2} = \left(\frac{2n\lambda \mp \lambda}{2}\right)$$

$$\boxed{2\mu t \cos r = (2n \mp 1)\frac{\lambda}{2}} \longrightarrow (9)$$

② condition for min / dark

$$\delta = (2n \pm 1)\frac{\lambda}{2}$$

$$\therefore 2\mu t \cos r \pm \frac{\lambda}{2} = (2n \pm 1)\frac{\lambda}{2}$$

$$2\mu t \cos r \pm \frac{\lambda}{2} = (2n)\left(\frac{\lambda}{2}\right) \pm \frac{\lambda}{2}$$

$$\boxed{2\mu t \cos r = n\lambda} \longrightarrow (10)$$