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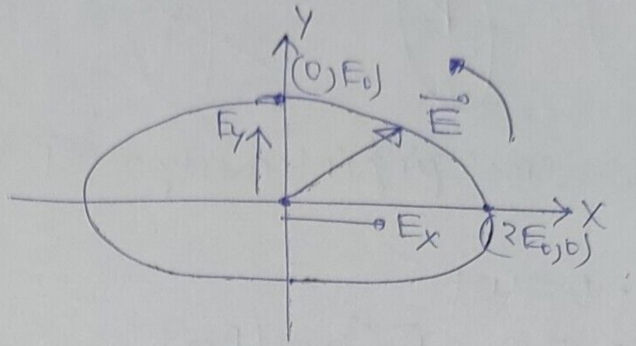
Subject: PHN-005 : Assignment (4)

1. angle b/w $\vec{E}$ and transmission-axis is = 45°
so: according to malus' law :-
fraction will be equal to $\cos^2\theta = \cos^2 45° = \frac{1}{2}$ Ans.

2. (a) $\phi = 0$:-

$$\left(\frac{E_x}{2E_0}\right)^2 + \left(\frac{E_y}{E_0}\right)^2 = 1$$

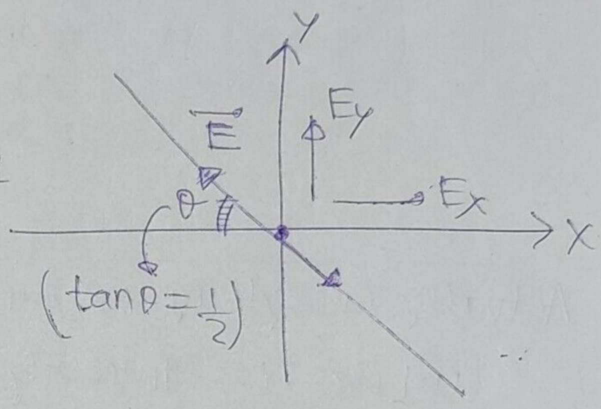
· It will elliptically polarised light.
(left-polarised).



(b) $\phi = \frac{\pi}{2}$:-

$$2E_y + E_x = 0 \Rightarrow \boxed{E_y = -\frac{1}{2}E_x}$$

· linearly polarised in xy-plane with angle with x-axis as $(\pi - \tan^{-1}(1/2))$.

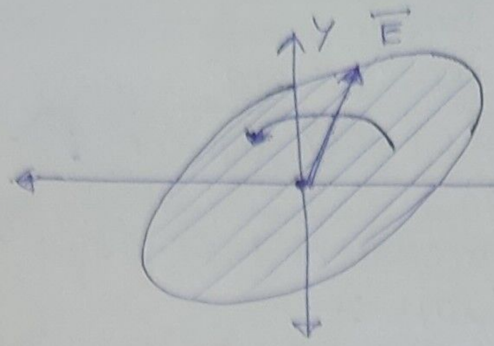


(c) $\phi = \frac{\pi}{4}$:-

$$\left.\begin{aligned} \frac{E_x}{2E_0} &= \cos\left(\omega t - kz + \frac{\pi}{4}\right). \\ \frac{E_y}{E_0} &= \sin(\omega t - kz) = +\cos\left(\omega t - kz - \frac{\pi}{2}\right) \end{aligned}\right\} \Delta\phi = \epsilon = \left(\frac{3\pi}{4}\right).$$

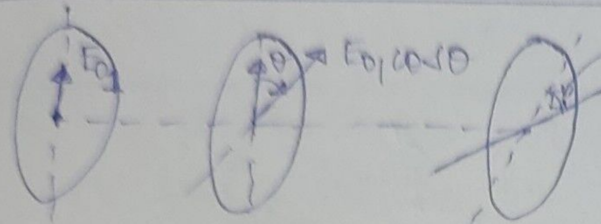
$\Rightarrow$ so it will be elliptically polarised in x-y plane with equation as :-

$$\boxed{\left(\frac{E_x}{2E_0}\right)^2 + \left(\frac{E_y}{E_0}\right)^2 - 2\cdot\left(\frac{E_x}{2E_0}\right)\left(\frac{E_y}{E_0}\right)\cdot\left(\frac{-1}{\sqrt{2}}\right) = \frac{1}{2}}$$ Ans.



{This will be an tilted ellipse.}

(3.)



$E_{01}\cos\theta\cos(90-\theta) = (E_{01}\cos\theta\sin\theta)$.

So: I = emerging intensity $= \langle \vec{E}^2 \rangle = \dfrac{E_{01}^2 \sin^2\theta\cos^2\theta}{2}$

- $\theta = \omega t$
- $I_1 = \langle \vec{E_{01}}^2 \rangle = \left(\dfrac{E_{01}^2}{2}\right)$.

$$= \frac{E_{01}^2}{16}\cdot(2)\left((1+\cos 2\theta)(1-\cos 2\theta)\right)$$
$$= \frac{E_{01}^2}{8}\left(1-\cos^2(2\theta)\right).$$
$$= \frac{E_{01}^2}{8}\cdot\frac{1-\cos(4\theta)}{2}$$
$$= \frac{(E_{01}^2/2)}{8}\left(1-\cos(4\omega t)\right)$$
$$= \frac{I_1}{8}\left(1-\cos(4\omega t)\right)$$ Ans

(4.) Actually everything is same but here : $I_1 = \left(\dfrac{I_i}{2}\right)$

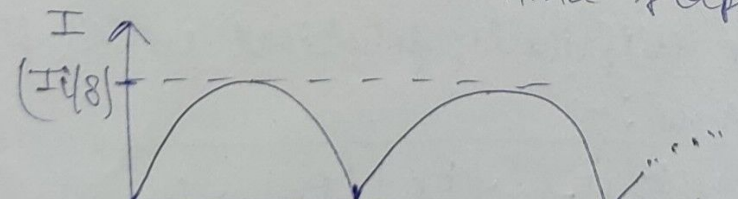
where I_i = Intensity of unpolarised beam

I_1 = Intensity of linearly polarised, passed through first polarizer.

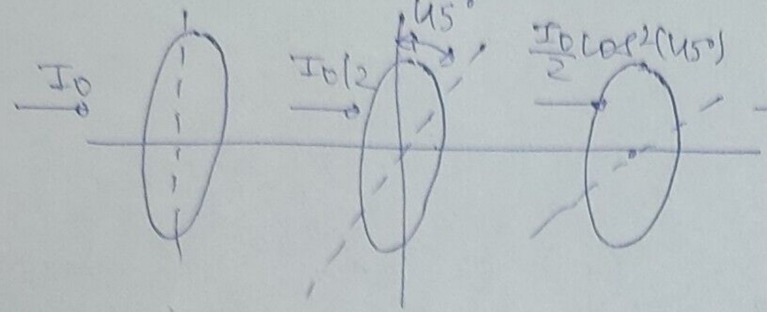
So from Ques: (3) # $I = \dfrac{I_1}{8}\left(1-\cos(4\omega t)\right)$

$$\boxed{I = \frac{I_i}{16}\left(1-\cos(4\omega t)\right)} = \frac{I_i}{8}\sin^2(2\omega t).$$

So it is sinus variation and hence graph will be:



when polaroid is fixed, then:



$\longrightarrow I_1 =$ final intensity $= \frac{I_0}{2}\cos^4(45°)$

$= \frac{I_0}{2}\left(\frac{1}{4}\right)$

$= \frac{I_0}{8}$ Ans

So, intensity becomes $(1/8)^{th}$ of initial.

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(5) Here, $d = 0.5mm$, $\lambda = 5\times10^{-7}m$, $D = 0.5m$

So: fringe width $= \beta = \frac{\lambda D}{d} = \frac{(5\times10^{-7})(1/2)}{\left(\frac{1}{2}\times10^{-3}\right)} = (5\times10^{-4})m$

$= 0.5mm$

Ans

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(6) A bulb at S would produce fringes. We can imagine it as made up of a very large number of incoherent point sources. Each of these would generate an independent pattern, all of which would then overlap. Bulbs at S_1 and S_2 would be incoherent and could not generate detectable fringes.