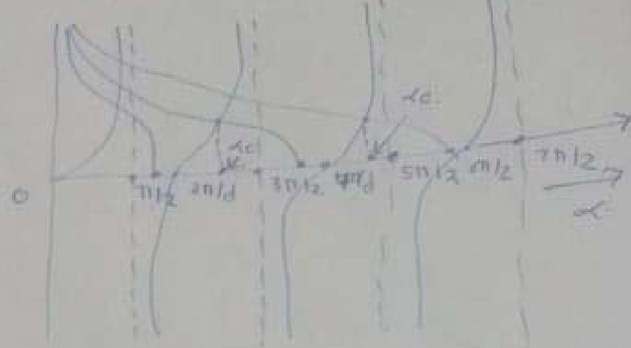
consider the plot (i) $\frac{\gamma}{\alpha}$ vs α (ii) $\frac{\gamma}{\alpha}$ vs $\tan(\alpha d/2)$.

γ/α vs α



wherever they intersect, gives solutions.

$\tan \frac{\alpha d}{2} = 0 \Rightarrow \frac{\alpha d}{2} = 0, \pi, 2\pi, 3\pi$

$\alpha = 0,\ 2\pi/d,\ 4\pi/d.$

$\tan \alpha d/2 = \pm \infty$ at $\pi/2,\ 3\pi/2,\ 5\pi/2.$

$\alpha = \pi/d,\ 3\pi/d,\ 5\pi/d.$

For symmetric TE modes in a planar dielectric wave guide with step-index profile

$\tan\left(\frac{\alpha d}{2}\right) = \left(\frac{\gamma}{\alpha}\right)$. where $\alpha^2 = k_0^2 n_1^2 - k^2$

$\gamma^2 = k^2 - k_0^2 n_2^2$

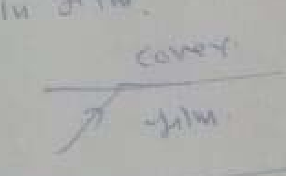
$$\frac{\gamma}{\alpha} = \left[\frac{k_0^2 (n_1^2 - n_2^2)}{\alpha^2} - 1\right]^{1/2}$$

$$= \frac{k_0^2 (n_1^2 - n_2^2)}{\alpha_c^2} - 1 = 0.$$

$$\alpha_c^2 = k_0^2 (n_1^2 - n_2^2).$$
$$= \left(\frac{2\pi}{\lambda}\right)^2 (n_1^2 - n_2^2).$$

$$\alpha_c = \frac{2\pi}{\lambda} (n_1^2 - n_2^2)^{1/2}, = \frac{\omega}{c} (n_1^2 - n_2^2)^{1/2}$$

Conclusions: ① $\alpha^2 > \alpha_c^2$. [wave guidance stops] in film.



$k_0^2 n_1^2 - k^2 > k_0^2 (n_1^2 - n_2^2).$

$-k^2 > -k_0^2 n_2^2$ or $\Rightarrow k^2 < k_0^2 n_2^2$

ie ~~γ^2 is negt~~ ie. γ^2 is negative.

for the wave to propagate γ^2 must be +ve.

The no. of TE modes propagating the WG decreases if α_c is decreased. If n_2 is slightly less than n_1 or wavelength is larger or frequency is small then α_c is small and wave propagation is not there.