* TE Mode

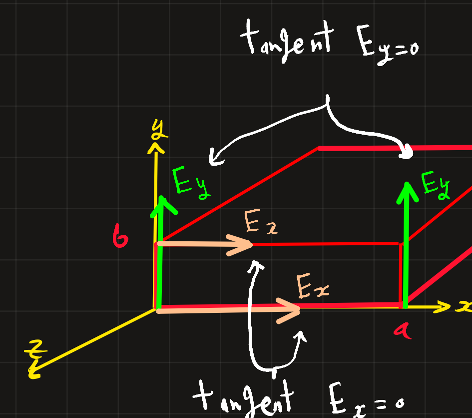
$\rightarrow E_z = 0$

$\rightarrow H_z = [C_1 \sin(Ax) + C_2 \cos(Ax)]\,[C_3 \sin(By) + C_4 \cos(By)]\, C_5\, e^{-j\beta z}$

$$\begin{bmatrix} E_x \\ H_y \\ E_y \\ H_x \end{bmatrix} = \frac{1}{K_c^2} \begin{bmatrix} -j\beta & -j\omega\mu & 0 & 0 \\ -j\omega\epsilon & -j\beta & 0 & 0 \\ 0 & 0 & -j\beta & j\omega\mu \\ 0 & 0 & j\omega\epsilon & -j\beta \end{bmatrix} \times \begin{bmatrix} \cancel{\frac{\partial E_z}{\partial x}} \rightarrow 0 \\ \frac{\partial H_z}{\partial y} \\ \cancel{\frac{\partial E_z}{\partial y}} \rightarrow 0 \\ \frac{\partial H_z}{\partial x} \end{bmatrix}$$

. Boundry Conditions :

→ Boundry Condition Won't be applied to H_z because it doesn't equal Zero at the boundry.

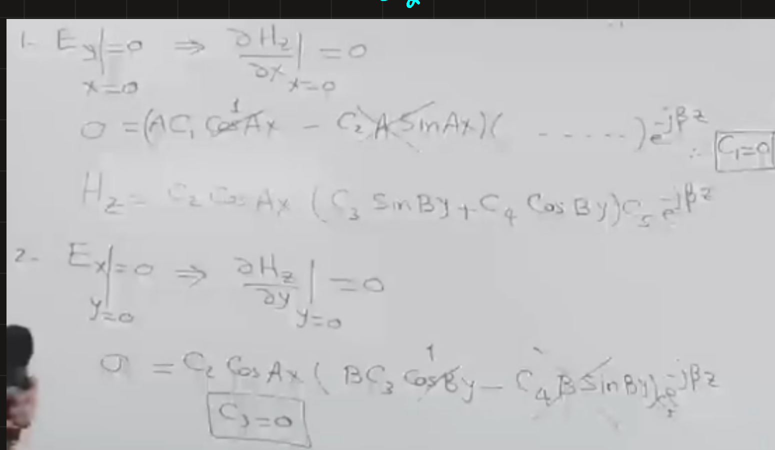


→ But E_x , E_y does

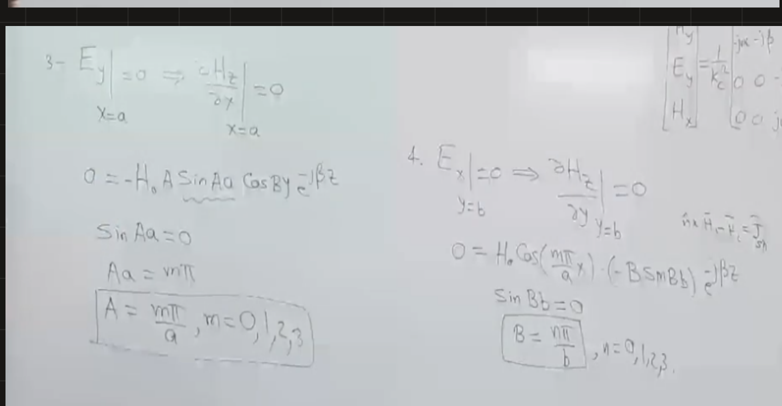
$$\underbrace{\therefore E_x\Big|_{y=0} = 0 \quad , \quad E_x\Big|_{y=b} = 0}$$ $$\underbrace{, \ E_y\Big|_{x=0} = 0 \quad , \quad E_y\Big|_{x=a} = 0}$$

→ From matrix :

$. \ E_x = -j\omega\mu / K_c^2 \cdot \frac{\partial H_z}{\partial y} = 0$ $\qquad . \ E_y = j\omega\mu / K_c^2 \cdot \frac{\partial H_z}{\partial x} = 0$



$$\therefore H_z = \overbrace{C_2 C_4 C_5}^{H_0} \cos(Ax) \cos(By)\, e^{-j\beta z}$$



$$\therefore H_z = H_0 \cos\left(\frac{m\pi}{a}x\right) \cos\left(\frac{n\pi}{b}\right) e^{-j\beta z} \quad , n = 0,1,2,3,\ldots \quad m = 0,1,2,3,\ldots$$

$$\therefore K_c = \left(\frac{\pi m}{a}\right)^2 + \left(\frac{\pi n}{b}\right)^2$$

$$\therefore f_c = \frac{v}{2}\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}$$

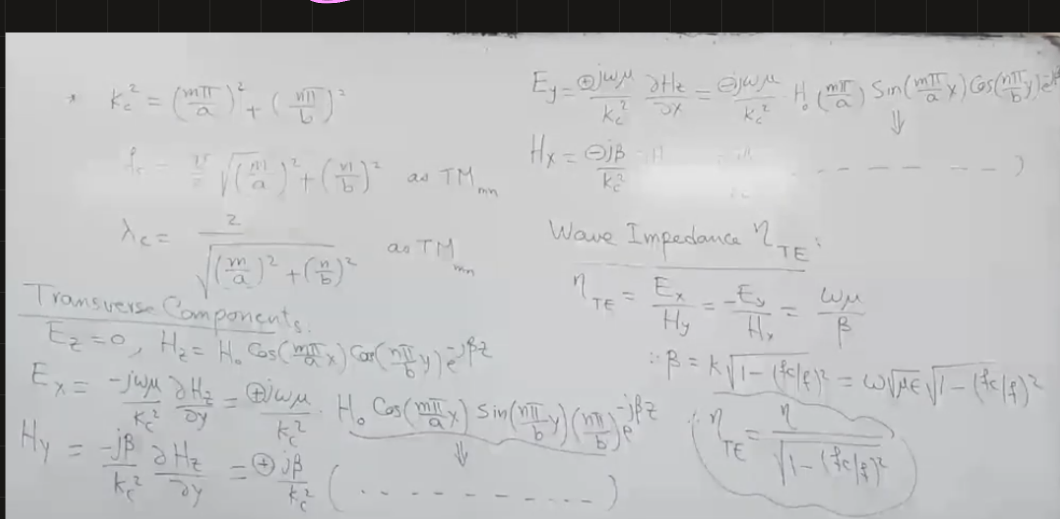
as TM

$\therefore F > F_c \quad , K > K_c$

$$\therefore \lambda_c = \frac{2}{\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}}$$

$\therefore \lambda < \lambda_c$

* Transverse Components :



→ Wave Impedance :

$$. \ \eta_{TE} = \frac{E_x}{H_y} = \frac{-E_y}{H_x} = \frac{\omega\mu}{\beta} \quad , \beta = K\sqrt{1 - (F_c/F)^2}$$

$$\beta = \omega\sqrt{\mu\epsilon}\ \sqrt{\quad}$$

$$\therefore \eta_{TE} = \frac{\eta}{\sqrt{1 - (F_c/F)^2}}$$