TM-Mode : $(H_z = 0)$ $E_z \neq 0$ 1/2

In the eq(23) we have

$$\frac{\partial^2 \bar{H}}{\partial x^2} + \gamma^2 \bar{H} = -\omega^2 \epsilon \mu \bar{H}$$

let $\bar{H} = H_y = H_{y_0} e^{-\gamma z}$

Then we have

$$\frac{\partial^2 H_{y_0}}{\partial x^2} + \gamma^2 H_{y_0} = -\omega^2 \epsilon \mu H_{y_0}$$

The Solution of the above equation is of the form given as

$$\frac{\partial^2 H_y}{\partial x^2} + H_y l^2 = 0 \quad \text{Where } l^2 = \gamma^2 + \omega^2 \epsilon \mu$$

& $H_{y_0} = (C_3 \sin lx + C_4 \cos lx)$ —— (40a)

Hence $H_y = (C_3 \sin lx + C_4 \cos lx) e^{-\gamma z}$

Applying Boundary Condition $x = 0$ $H_y = 0$
$C_3 = 0$

& $x = a$ $H_y = 0$ $\Rightarrow l = \left(\frac{m\pi}{a}\right)$

$$H_y = C_4 \cos lx \, e^{-\gamma z} \quad \text{—— (41)}$$

From eq(20) $\frac{\partial H_y}{\partial x} = j\omega \epsilon E_z$

(40a) ⇒

$$\frac{\partial H_y}{\partial x} = \frac{m\pi}{a} (C_3 \cos lx - C_4 \sin lx) e^{-\gamma z}$$

$$E_z = \frac{m\pi}{j a \omega \epsilon} (C_3 \cos lx - C_4 \sin lx) e^{-\gamma z}$$

Applying B.C
at $x = 0$
$C_3 = 0$

$$E_z = -\frac{m\pi}{j a \omega \epsilon} C_4 \sin lx \, e^{-\gamma z} \quad \text{—— (42)}$$

Contd.

Applying boundary Condition to eq (41) we get

$$H_y = C_4 \cos \frac{m\pi}{a} x \, e^{-\gamma z} \quad \text{—— (43)}$$

From eqn No. (25) $E_x = -\frac{\gamma}{l^2} \frac{\partial E_z}{\partial x}$

$$\frac{\partial E_z}{\partial x} = \left(\frac{m\pi}{a}\right)^2 \frac{l}{j\omega\epsilon} \left(-C_3 \sin lx + C_4 \cos lx\right) e^{-\gamma z}$$

$$\frac{l^2}{j\omega\epsilon} \left(+[C_3 \sin lx \quad C_4 \cos lx\right) e^{-\gamma z} \therefore \left(\frac{+\gamma}{l^2}\right) = E_x$$

$$E_x = \frac{\gamma}{j\omega\epsilon} \left(C_3 \sin lx + C_4 \cos lx\right) e^{-\gamma z}$$

Applying boundar Condition we have

$$E_x = \frac{\gamma}{j\omega\epsilon} C_4 \cos\left(\frac{m\pi}{a}\right) x \, e^{-\gamma z} \quad \text{—— (44)}$$

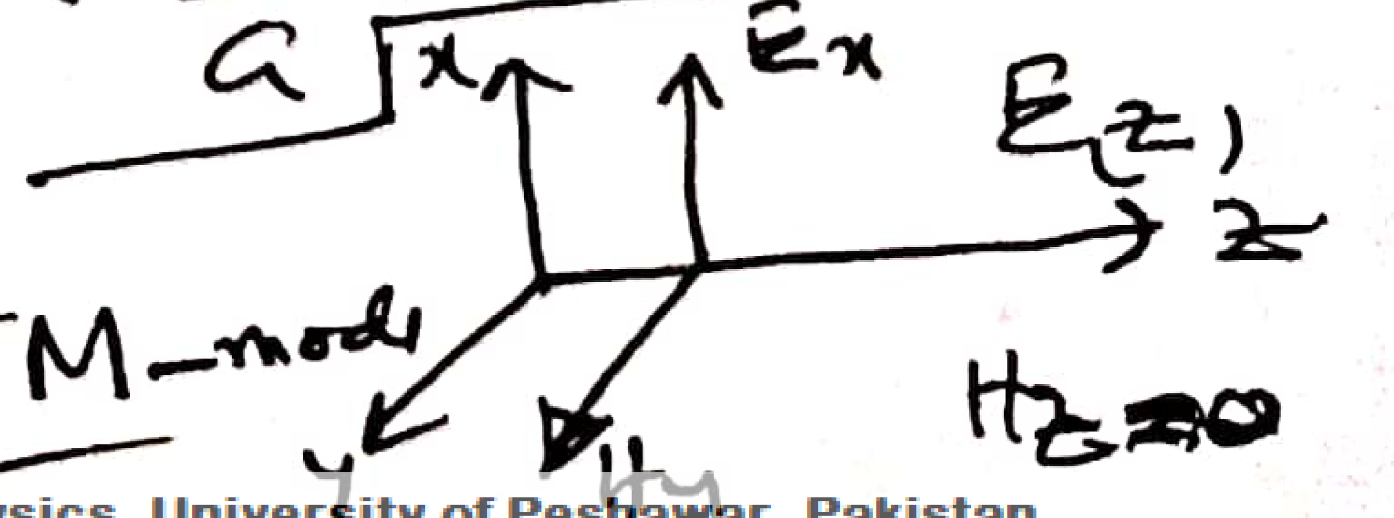
Since $\gamma = -\beta z$ as $\alpha = 0$ for the wave propagation we have

$$H_y = C_4 \cos\left(\frac{m\pi}{a} x\right) e^{-j\beta z} \quad \text{—— (45)}$$

$$E_x = \frac{\beta}{\omega\epsilon} C_4 \cos\left(\frac{m\pi}{a} x\right) e^{-j\beta z} \quad \text{—— (46)}$$

&

$$E_z = \frac{-m\pi}{j\omega\epsilon a} C_4 \sin\left(\frac{m\pi}{a} x\right) e^{-j\beta z} \quad \text{—— (47)}$$



TM-mode