Reading Today: Chillwell Sec. 1, 2.

Monday: Chill well Sec. 3, 4.

How EM waves interact w/ layered materials.

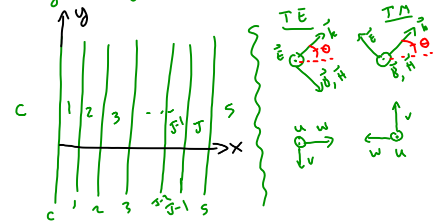
Today: - Background

- Reflection / Transmission

Monday: - Waveguiding

- power/momentum in a waveguide.

The geometry of our current problem



For plane waves: $B = \frac{E}{v} = \frac{nE}{c}$

$$\Rightarrow H = \frac{1}{\mu_0} B = \frac{nE}{\mu_0 c} = \frac{n\sqrt{\mu_0 \epsilon_0}\, E}{\mu_0}$$

$$\boxed{H = \frac{nE}{\sqrt{\mu_0/\epsilon_0}} = \frac{nE}{Z_0}\ ;\ Z_0 = \sqrt{\frac{\mu_0}{\epsilon_0}}}$$

Let's define a new var $\boxed{\rho = \begin{cases} 0, & TE \\ 1, & TM \end{cases}}$

Define: $\boxed{\alpha = n\cos\theta}$; $\theta = \measuredangle$ of incidence from normal

$\boxed{\beta = n\sin\theta}$ $\boxed{\alpha = \sqrt{n^2 - \beta^2}}$

β is the same in all layers.

$$\boxed{\gamma = \begin{cases} n\cos\theta / Z_0 \ \text{(or)}\ \alpha/Z_0, & TE \\ Z_0 \cos\theta / n \ \text{(or)}\ \alpha Z_0/n^2, & TM \end{cases}}$$

$$\boxed{u = \begin{cases} E_z & TE \\ H_z & TM \end{cases}}$$

Transverse field

$$\boxed{v = \begin{cases} -H_y & TE \\ E_y & TM \end{cases}}$$

$$\boxed{w = \begin{cases} H_x & TE \\ -E_x & TM \end{cases}}$$

$$\boxed{\text{Other crap} = \emptyset = \begin{cases} H_z = E_y = E_x \\ E_z = H_y = H_x \end{cases}}$$

Alternatively for γ: $\gamma = \frac{\alpha Z_0^{2\rho - 1}}{n^{2\rho}}$

It turns out

$$\boxed{v = \frac{\gamma}{ik\alpha}\frac{\partial u}{\partial x} \; ; \; w = \frac{\beta\gamma}{\alpha} u \; ; \; u = \frac{1}{ik\gamma\alpha}\frac{\partial v}{\partial x}}$$

Blah blah blah, matrix, boundary condition, math, more math.

$$\begin{pmatrix} u_{j-1} \\ v_{j-1} \end{pmatrix} = M_j \begin{pmatrix} u_j \\ v_j \end{pmatrix}$$

$$M_j = \begin{pmatrix} \cos\Phi_j & -\frac{i}{\gamma_j}\sin\Phi_j \\ -i\gamma_j \sin\Phi_j & \cos\Phi_j \end{pmatrix}$$

$$\Phi_j = k\alpha_j \underbrace{(x_j - x_{j-1})}_{\text{thickness of the layer}}$$