Solution to 1

1 Loss less line $R' = 0$, $G' = 0$ and $\alpha = 0$

1 $Z_0 = R_0 = \sqrt{L'/C'}$

$\beta = \omega \sqrt{L'C'}$

1 divide $Z_0/\beta = \dfrac{R_0}{\beta} = \dfrac{1}{\omega C'}$

1 $C' = \dfrac{\beta}{R_0 \omega} = \dfrac{3}{2\pi \times 100^8 \, (70)} = 68.2$ pF/m

1 $L' = R_0^2 C = (70)^2 \, (68.2 \times 10^{-12})$

$= 334.2$ nH/m .

5 points .

Solution to 2. (1) $z_L = \frac{Z_L}{Z_0} = \frac{40+j30}{100} = 0.4 + j0.3 = r_L + jx_L$

(2) locate z_L on Smith chart

Draw the SWR circle

Then y_L is opposite to z_L on SWR circle.

$y_L = g_L + j b_L = 1.6 - j1.2.$

Alternately $y_L = \frac{Z_0}{Z_L} = \frac{100}{40+j30}$ x by c.c.

$= 1.6 - j1.2.$

(3) Draw $g=1$ circle.

The SWR circle intersects the $g=1$ circle at points

A $y_A = 1 - j1.04 \pm 0.02$

B $y_B = 1 + j1.04 \pm 0.02$

So the shunt impedence must be

A $y_s = +1.04$

B. -1.04

(4) Thus the required shunt admittance is

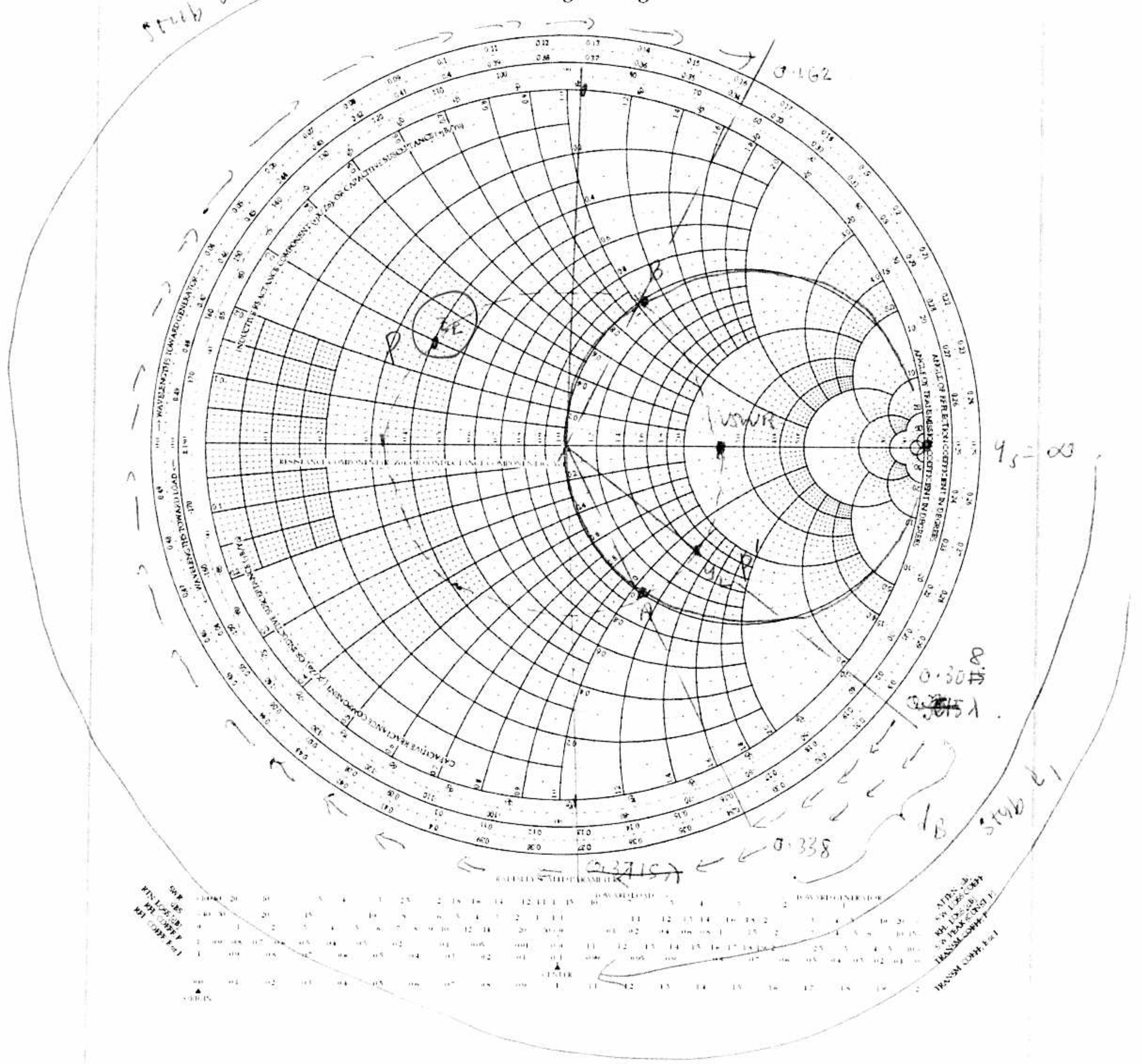
$Y_s = Y_0 y_s = \pm j1.04 \left(\frac{1}{100}\right) = \pm j10.4\ mS.$ (Ω^{-1})

Both are possible values

Problem2

The Complete Smith Chart

Black Magic Design

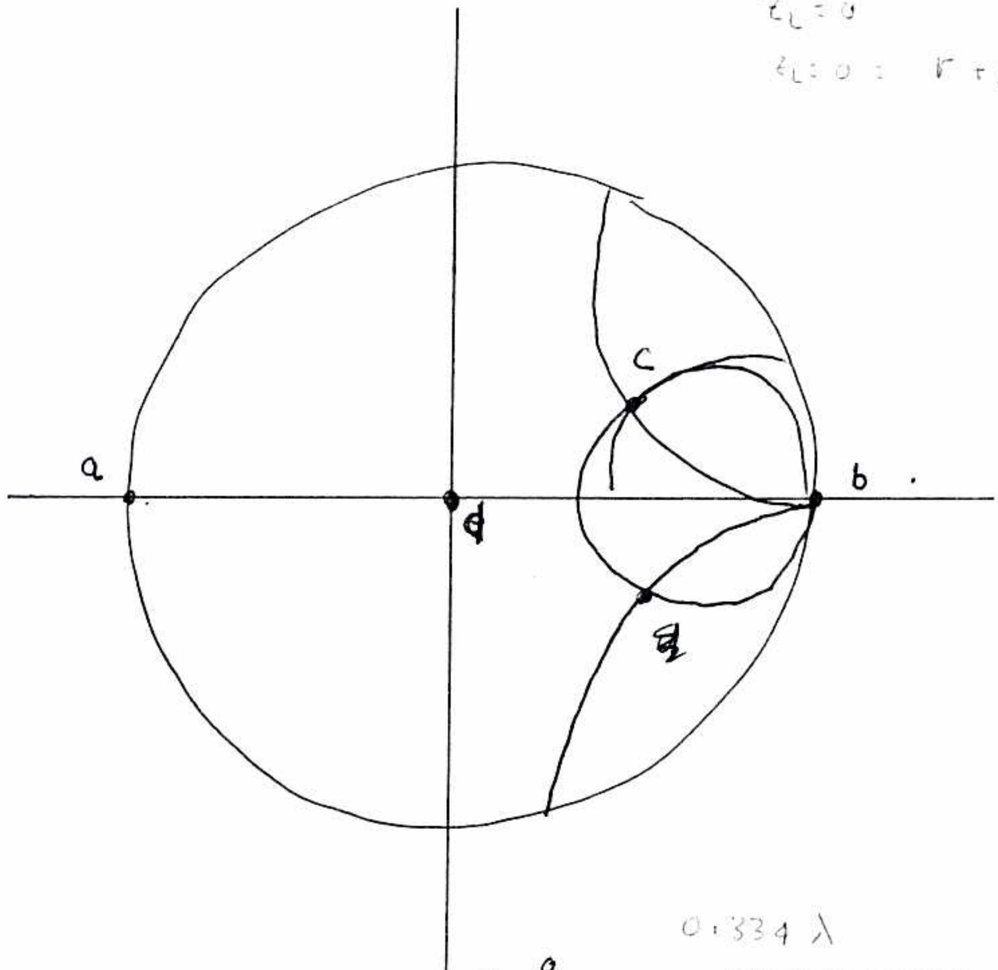


Solution no 3.

$Z_L = 0$

$z_L = 0 = r + jx$

i)



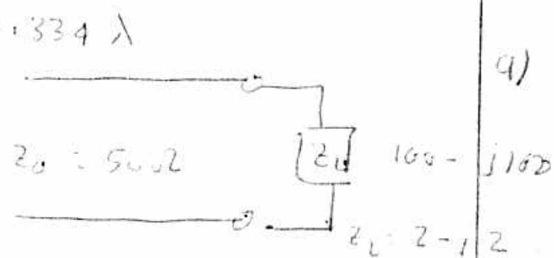
a = 1

b = 1

c = 1

d = 1

ii) a) $0.61\, e^{-j30^0}$



a) 3

b) 4.3

b) 2

?

c) $Z_{in} = 22.5 + j45\,\Omega$ ($0.25 + j47\Omega$) c) 3

o.k as well

d) $0.208\,\lambda$. d) 3

$0.21\,\lambda$

Solution to 4 · $f\lambda = u_p$ and $u_p = c/\varepsilon_r^{1/2}$ 2

$$u_p = \frac{3\times10^8}{\sqrt{3.62}} = 1.58\times10^8 \quad m s^{-1}$$

$$\lambda = u_p/f = \frac{1.58\times10^8}{400\times10^6} = 39.4 \text{ cm}.$$ 1

3.35λ.

but $l = 1.32$ m

$Z_{in} = 40 + j65\,\Omega$ Z_L

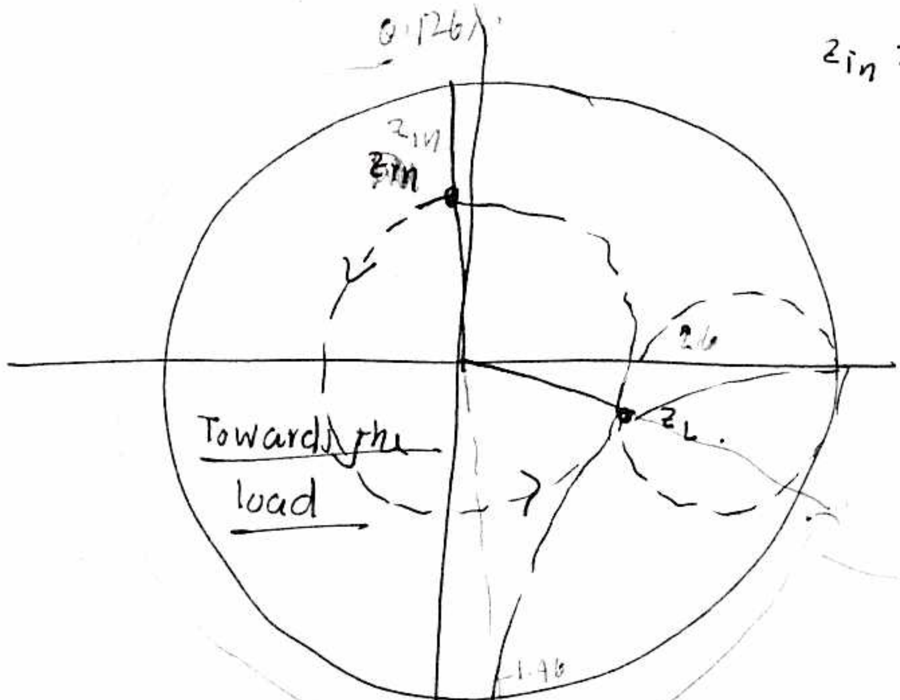
$l/\lambda = 3.35\lambda$. 2

$1/2$ wavelength towards the generator is ~~$\lambda/2$~~ 360^0.

$3\lambda = 6$ times round

$0.35\lambda = 2 \times 0.35 \times 360^0 = 2\times 126^0$. 252^0 anticlockwise

~~at~~ from Z_{in}.



$$z_{in} = \frac{40 + j65}{75}$$ 2

$$= 0.53 + j0.86.$$

Now move a distance 0.35λ toward the load 2

This corresponds to $z_L = 2.6 - j1.46$?

$\boxed{Z_L = Z_0 z_L = 196 - j109\,\Omega}$

Solution 04

The Complete Smith Chart

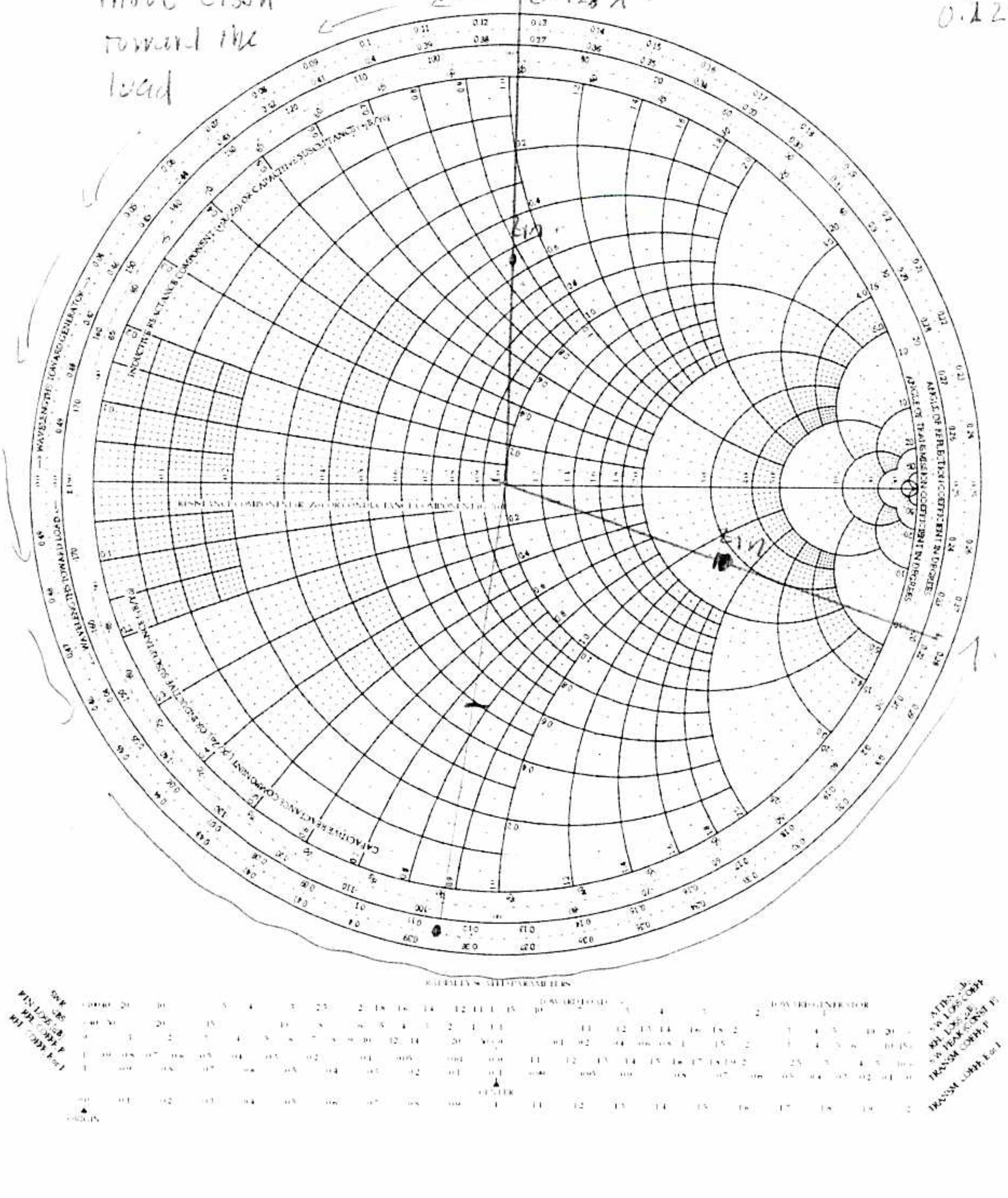
Black Magic Design

0.126 λ

move 0.35λ toward the load

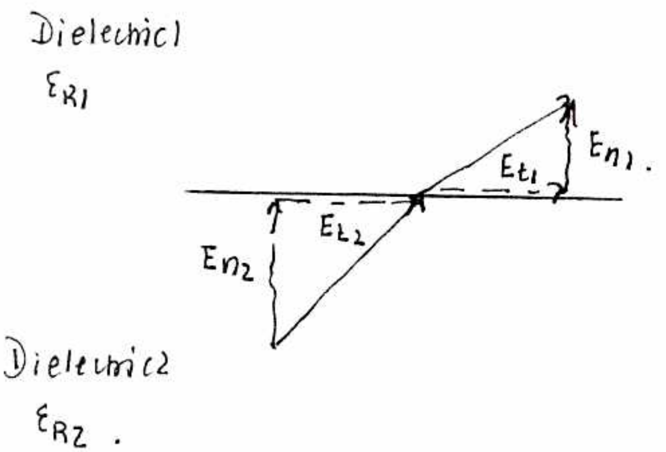
0.35 - 0.126 = 0.224

0.5 - 0.128 = 0.374



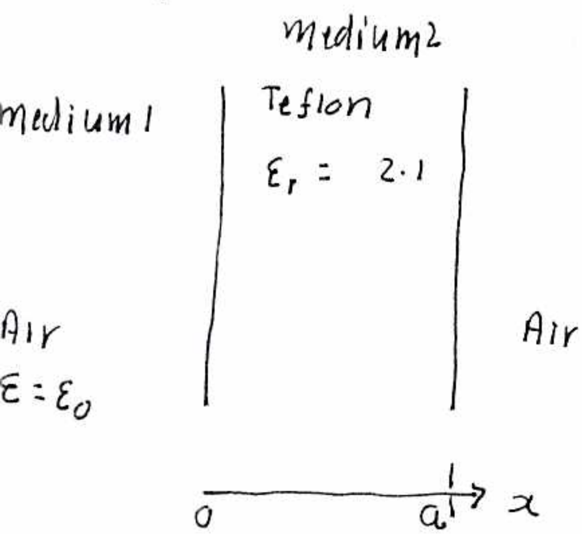
lution 05 What are the boundary conditions for the tangential and the normal components of the electric field intensity and the electric flux density between two dissimilar dielectrics with ε_{R1} and ε_{R2}.

$$E_{t_1} = E_{t_2} \qquad \frac{D_{t1}}{D_{t2}} = \frac{\varepsilon_{R1}}{\varepsilon_{R2}}$$ 2



$$D_{N_1} = D_{N_2}$$ 2

$$\varepsilon_{R1} E_{N_1} = \varepsilon_{R2} E_{N_2}$$



A slab of teflon thickness a and $\varepsilon_r = 2.1$ is immersed in a uniform external field $\hat{x} E_0$

Use the dielectric boundary conditions to calculate the electric field E_i, inside the teflon, the polarization flux density $\underline{P}$ and the electric flux density D_i inside the teflon. (Assume ρ_s, the surface charge density is zero).

$$D_{n_1} = \varepsilon_0 E_{n_1} = \varepsilon_0 E_0 = D_{n_2} = \varepsilon_0 \varepsilon_r E_{in}$$ 1

$$D_{n2} = \varepsilon_0 E_{in} + P_{in}$$

$$P_{in} = D_{n2} - \varepsilon_0 E_{in}$$

$$= \varepsilon_0 \left(E_{o} - E_{in} \right)$$

$$= 0.524\, \varepsilon_0 E_0$$

$$D_i = D_0 = \varepsilon_0 E_0 .$$